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ESTABLISHING A WELL ROUNDED COMMERCIAL POLICY.

A somewhat extended study of central-station practice inclines one to the belief that a more comprehensive commercial policy needs to be adopted in many instances before the local field can be drawn upon for the maximum return in energy sales consistent with its industrial and social conditions. There are undeveloped lines of attack upon the conservatism of consumers which ought to be thoroughly exploited, and it is a singular fact that in not a few cases some of the most obvious ways of creating new business are overlooked. Thus one company serving over 75,000 people at extremely reasonable rates both for power and lighting maintains no exhibit of the latest energy-consuming devices at its offices, and while it has arranged for its customers to pay monthly bills at a number of retail stores scattered throughout its territory, its main offices are several thousand feet from the principal business street of the town, too far to walk in a hurry and accessible by a comparatively infrequent trolley service over which it naturally has no control. Yet this central station is thoroughly well managed; its employees are noted for the courtesy and pains which they take to serve the public well; and among discriminating people it stands as high as practically any concern in the place. The only trouble is that its full opportunities remain to be realized through the constant display of up-to-date electrical devices in show-window space passed daily by many thousands of people, by increasing the amount of time and energy put on securing new lighting business, and by going out to meet the people with new means of adding to their comfort and convenience rather than depending upon solicitation mainly by personal contact unsupported by the maintenance of a continuous exhibit of appliances at the home office and down town.

Supplemented by one or two solicitors capable of devoting a good share of their time to the lighting field in addition to those who are now ably canvassing the power territory, and given an inexpensive but well polished and flexible display of appliances where the public is bound to see it, and the present excellent record of the concern would be raised to a plane which would be gratifying both to itself and those consumers who are at present unaware of the enormous variety of electrical equipment available for their domestic use.

FINANCIAL STANDING OF THE ELECTRICAL CONTRACTOR.

The reputation of the electrical contractor in financial matters is bad. We have heard it over and over again, from those who say they know, that as a credit risk he is one of the poorest. There has been so much talk of this kind that a person not well informed as to the actual facts might easily conclude that electrical contractors as a class were practically devoid of ordinary business intelligence, or else that they were men not supplied with an ordinary amount of honesty. Either conclusion, however, would be very unfair as applying to individuals who really have a right to be considered electrical contractors.

Electrical contractors in this country can be divided into two pretty well defined groups: those, on the one hand, who appreciate the opportunities of the contracting business where it can be carried on along sane and proper lines, and have taken up the work to make a success of it as a permanent business or profession; and, on the other hand, men who, with but little capital, or none at all, and with no other qualifications than practical experience as electricians acquired in the service of some central station, or as employees of another contractor, take up electric wiring as a sort of makeshift to be followed until something more profitable turns up, or until their own poor management compels them to quit the business. It is the debts that contractors of the latter class never pay, more than anything else, that make the credit rating of the electrical contractor so low. The real electrical contractor is probably well above the average as a credit risk.

The remedy for the unfortunate operations of the unreliable contractor is rather largely in the hands of the dealer in wiring supplies. By giving credit where it was not safe nor deserved, dealers in some localities have apparently made it much too easy for men to go into the contracting business who should have kept out of it, and for them to continue the practice of unwarranted price cutting and other performances ruinous to their competitors and unfortunate for the dealer. The supply man can greatly promote the electrical contracting business by keeping himself posted as to the business methods of the contractors in his territory and declining to extend favors to those who do not conduct their affairs along lines that are recognized to be safe.

Nothing in the foregoing is to be taken as any criticism of the small contractor, nor of the man who leaves the position of wage earner to become a contractor. If a man prefers to conduct his business on a small scale, that is his own affair. We could even fraternize with the much criticised "curbstone" contractor without fear of having our morals corrupted, provided he was a man who sought only such jobs as a contractor of his type could handle well, and that he insisted on a reasonable price for doing these and paid his bills when he got his money. It is a praiseworthy desire, to be sure, for a man to prefer to have his own business and be his own manager rather than be a wage earner. But before he goes into the electrical contracting business he ought to make sure that he is not better fitted to be the employee of some one else. And those whose favors make it possible for him to go into the business can well afford to study his methods closely until his reputation is well established.

ELECTRICITY IN COAL MINING.

The meeting of the American Institute of Electrical Engineers at Pittsburgh last week was devoted to the subject of the use of electricity in mines and dealt almost entirely with coal mining. The papers and discussion at this meeting were rather unique in the consensus of opinion which was disclosed in regard to two points: (1) the very unsatisfactory condition existing in most coal mines with regard to the methods of operation and the care given to the electrical equipment; and (2) the general recognition accorded by the engineers of the coal-mining companies as well as by those representing manufacturers and central stations as to the undeniable desirability of using central-station power in this industry.

There is now a demand for more rugged apparatus than is to be found in the standard lines of the electrical manufacturing companies, and the day has passed when the mines will refuse to purchase such apparatus on account of a greater expense. Any investment which will cut down repair charges would be an economy.

While some of the conditions revealed in this discussion are already on the way to betterment and have already been largely eliminated by the more progressive companies, there are undoubtedly many localities in which these conditions exist at the present time. Power plants owned by the mining companies are usually run without much regard to efficiency and by a class of workmen incapable of giving either the power equipment or the mining machinery the proper kind of attention. The conditions of transmission and distribution lines, as described by those familiar with such installations, must be very generally unsatisfactory.

While the condition of such equipment and the treatment accorded motors and other machinery in the mines does not depend upon the source of power, at least those troubles having their origin in the isolated power houses can be corrected by purchasing power from the central station, and the general satisfaction expressed by mine owners who have followed this course would indicate that it is a desirable move in every instance. Two of the papers dealing with this phase of the subject are reproduced at some length in this issue and supply strong evidence of the feasibility of the central station's obtaining this type of load. Further evidence to this effect was given in the issue of March 1.

SAFEGUARDING VISITS TO THE STATION.

As the size, value and voltage of power-plant electrical equipment increase, the problem of taking care of visitors to the station becomes one of no little complexity from the standpoint of safety and continuity of operation. The larger the station, generally speaking, the more important becomes the problem of dealing fairly and yet strictly with the pass-holder. In small plants the number of visitors present at any one time is usually low enough to be cared for by the operating force on duty at the time without much difficulty, but the situation in a big station is altogether different. Leaving out the legal responsibilities of the company toward the pass-holder—and it is a question if these can be nullified by printing on the back of the pass the fact that the visitor assumes the risk—it is of the utmost practical importance to protect both the generating system and the outsider from any possibility of accident. Except in very unusual conditions, or where the visitor is known to be competent to assume all necessary precautions, the old practice of turning the man with the pass loose in all parts of the station is rapidly becoming out of date on the more important systems, and wisely so.

There is no good reason why visiting hours should not be limited in the generating plant as closely as in a hospital or museum. It is well to encourage visits to the station by carefully guided parties, but in such cases too much care cannot be taken to determine in advance the number to be handled and to assign at least one guide in large installations to every eight or ten visitors. Access to bus compartments, switch rooms and switchboard galleries should be no part of the program of the average visiting party, which can obtain a full supply of novel sensations from the floor of the engine or turbine room or from the firing aisle of the boiler plant. The hazardous portions of the plant should not be thrown open to outsiders unless closely accompanied by responsible employees, even in cases where the former are competent to teach others the general features of the installation, as in the case of instructors in physics, manual training or other allied branches who may desire to pilot large groups of pupils through the establishment at subsequent times. Where a number of visitors greatly in excess of that arranged for arrives at the station, it is desirable to subdivide the groups as far as possible with the guiding facilities available, and if the limits above mentioned are exceeded, there is often grave danger of accident or interference with the proper operation of the system.

If enough men cannot be detailed to guide parties it is better to make some of the visitors wait until the others have made the tour through the building under such oversight as is available. It ought not to be necessary to point out the importance of requiring umbrellas and metal tripods to be left at the entrance, but too much care cannot be taken to avoid accident through contact with live or movable equipment parts, to keep the groups of visitors small enough to prevent crowding any one against the apparatus, and to exert the most rigid watch against unauthorized handling of valves, cocks or switches. For the general public a short tour through the main aisles of the plant should suffice. The welcoming of technically competent and responsible visitors is another matter entirely, but so far as pass-holders in general are concerned, stricter rules are in the interest of safety.

ANOTHER TESTIMONIAL TO NEWSPAPER ADVERTISING.

An interesting result of an agitation for lower gas and electric rates is reported by the Southern California Edison Company. This company serves the town of Pomona, Cal., a growing community of 15,000 inhabitants, a portion of whom held that the company's rates for electricity and gas were too high and should be summarily reduced.

This contingent of citizens demanded that the City Council pass ordinances reducng not only these rates but the rates charged for water as well. Failing in these demands they themselves initiated suitable ordinances and presented them to the Council. The latter, holding that it was not qualified to pass on the questions involved, exercised its right to present the ordinances to the citizens to be decided by popular vote. At this election the people of Pomona voted by a majority of about two to one against the reductions stipulated.

This action was due in a very large measure to the energetic newspaper publicity methods employed by the Edison Company. In the campaign carried on during the agitation, the company laid before the people sworn statements regarding investment, cost, revenues, etc. The entire proposition was frankly discussed much as one business man would discuss a business proposition with another.

The result, of course, amply justifies the general policies and methods pursued. It does more, however—it indicates the truth in the assertion that it pays to take the public into confidence, and further, it is a glowing testimonial to the value of newspaper advertising. It is also a striking demonstration of the fairness of the average citizen and the satisfactory outcome of the method of initiative and referendum where the public is made acquainted with the facts of the case. The ordinary citizen can be more depended upon to accord fair treatment to the investors in a public utility than can the politician of the type frequently dominant in city councils. Where the corporation does not itself dominate the political machine (and this is growing more and more difficult), its interests are safer under democratic machinery than under the autocratic sway of a political ring, at least where sufficient information is made available to formulate an enlightened public opinion.

New England Electric Vehicle Convention.

A convention of central-station men, electric-vehicle manufacturers, and dealers in accessories, together with local managers for these concerns, is being arranged to be held in Boston, May 20 and 21, under the auspices of the New England Electric Vehicle Association of America, and the Electric Motor Car Club of Boston. The purpose of the gathering is to stimulate an interest in the electric vehicle among power-station managers, to bring manufacturers in touch with conditions in the New England territory and to enlist the further interest of accessory dealers and agents in the promotion of the electric truck and pleasure car. All New England is included in the scope of the conference. Addresses are expected from well known experts on subjects of vital interest, among them, "New England as a Field for the Electric Motor Car," "Sales and Service," "Advertising," "Constructive Criticism from the Standpoint of Manufacturer and Central Station."

E. S. Mansfield, vice-president of the Boston Electric Motor Car Club, is chairman of the general committee that has the convention in charge, and O. G. Draper, business secretary of the Club, is the secretary. The committee is sub-divided as follows: Entertainment—Day Baker, E. W. M. Bailey, D. C. Tiffany. Finance—Fred M. Kimball, J. A. Hunnewell, S. F. Smith. Headquarters—L. L. Edgar, Robert C. Gregg, E. H. Hewins. Invitation and Attendance—J. A. White, Eugene Carpenter, F. W. Smith. Parade—F. N. Phelps, E. D. Dodge, H. S. Knowlton, F. J. Stone. Program—H. F. Thomson, E. R. Davenport, George W. Holden, Howard T. Sands, F. D. Stidham.

Publicity Committee of Electric Vehicle Association Institutes Active Campaign.

The Publicity Committee of the Electric Vehicle Association of America, Frank W. Smith, vice-president of the United Electric Light & Power Company, New York, chairman, has begun a vigorous campaign for the prosecution of publicity and advertising for the coming year. The committee has prepared and is now sending out a series of letters to the contributors to the first year's campaign fund, to those who did not contribute to this fund, to every central station in the country, to the members of the Electric Vehicle Association, to the manufacturers of electric vehicles and manufacturers of electric-vehicle accessories. It is the desire of the committee to raise for the next campaign a fund of $75,000. Fifty thousand dollars was raised last year and the results of this campaign have been of the greatest satisfaction to every one contributing to it. Inquiries and leads from every city in the Union, and from more than 25 foreign countries, have been received as a result of the publicity.

Railway Electrical Engineers.

The Association of Railway Electrical Engineers will hold its annual convention at the Hotel LaSalle, Chicago, Ill., October 18 to 24, inclusive. All of the prominent manufacturers of railway electrical supplies will exhibit, the ball room of the hotel having been turned over to them for that purpose.

W. J. Cartwright, of the Lehigh Valley Railroad Company, is president of this Association and Joseph A. Andreucetti, of the Chicago & Northwestern Railway, is secretary.

The growth of this Association, which was organized five years ago, indicates the great interest that is being shown by the railroad companies in electrical improvements. The prospect of electrification of the railroad terminals in Chicago, as well as the general adoption of electric lighting on railroad cars throughout the country, will give this exhibit of electric railway appliances an additional interest.

Joint Meeting of New England Section and Boston Company Section, National Electric Light Association.

A joint banquet and get-together meeting of the New England Section and the Boston Edison Company Section of the National Electric Light Association will be held at the American House, Boston, on Friday, May 2. The banquet will be an informal one and is arranged for 6:30 p. m. A number of striking and highly interesting entertainment features including oratorical, music, moving-picture and other "stunts" will be provided. The banquet tickets ($2.00 each) can be secured from O. A. Bursiel, 149 Tremont Street, Boston, Mass.

La Crosse Gas and Electric Association.

The second monthly meeting of the La Crosse Gas and Electric Association was held on Tuesday evening, April 15.

A very interesting paper on the manufacture of gas was read by John A. Patten, who has charge of the reconstruction of the local gas plant. The discussion of this paper closed the formal session and the members then enjoyed selections from the graphophone. Refreshments and dancing concluded the meeting at which over 35 were present.

The Pupin Inductor.

Michael I. Pupin, professor of electro-mechanics at Columbia University, New York, described his new invention, which he will probably call the "Pupin inductor," before the American Philosophical Society at its meeting last week. Elihu Thomson, who introduced Dr. Pupin, assured those present that the invention would make it possible to send a wireless message around the world. In commenting on his invention, Professor Pupin had the following to say:

"Understand that I have made no boasts about my invention. I make it a rule when I have solved some interesting problem of electro-mechanics to make my announcement before a body of scientists and to let them praise the merits of the invention. Dr. Thomson was extremely enthusiastic. I didn't say that my rotating armature will mean round the world wirelessing, but since Dr. Thomson has been kind enough to assert that I won't deny the possibility.

"The great difficulty with wireless communication has been that the electric waves weaken so that it is impossible to send messages many thousands of miles. Atmospheric conditions and other causes have limited wireless signaling to about 3,000 miles. By using baloons, Marconi sent messages 3,000 miles. Between land stations 2,000 miles has been about the maximum distance.

"I have invented a device by which the electric current is put in inductive relation with a rotating armature of a motor. When a signal is received it acts at once on the rotating armature, and the rotating feature serves to increase vastly the strength of the current and the magnetic power, thereby assuring greatly extended communication.

"The rotator serves another purpose almost as important. It suppresses confusing signals. Take, for instance, a ship in the English Channel, a waterway where there is much interference in wireless communication brought about by the great number of ships and land stations using wireless systems. By the use of my invention a ship in the Channel could receive uninterruptedly and clearly and send with the same absence of confusion although 100 ships and stations were signaling at the same time. My invention is an entirely new form of transmitting and receiving circuit.

"My inductor can be applied to any form of electric communication, and I believe that it will be as successful with wire communication as with wireless signaling. I shall probably call it the 'Pupin Inductor.'"

W. A. Layman.

It is with genuine appreciation and substantial pleasure that the opportunity arrives for reviewing the career of an exceptionally energetic and successful young man. The election of Waldo Arnold Layman on April 10 to the presidency of the National Metal Trades Association, is an important event. It indicates that not only among his own immediate associates in the business with which he is connected, but in the larger field of universal opportunity and contact with other big men, he has been recognized as a leader of marked ability, and this tribute is paid to his distinction as an executive.

Mr. Layman graduated from the Rose Polytechnic Institute with the degree of B. S. in 1892, at the age of 22. Shortly afterward, he entered the employ of the Wagner Electric Manufacturing Company as utility man, making all the drawings for the company's first transformers and direct-current motors. After becoming identified with the work which led to the development of the first commercially successful Wagner single-phase motor, Mr. Layman was promoted to the position of assistant superintendent and, four years later, to that of assistant manager. In 1899 he was given the degree of E. E. and in 1900 was made the treasurer of the Wagner company. Two years later he was made the general manager as well, which two positions he filled until 1908, when he was made first vice-president and general manager. Upon the death of S. M. Dodd, the president, in February of 1912, Mr. Layman succeeded him.

W. A. Layman,
President Wagner Electric Manufacturing Company.

Like all manufacturing companies, the Wagner company has undergone the usual vicissitudes in developing a substantial line of manufactred products and a well rounded-out organization. Mr. Layman played an active part in the correcting of all troubles of the company, and it was probably his efficiency in handling troubles, with apparatus and otherwise, that resulted in placing him at the helm when a general change of organization was made in 1902.

His engineering work for the company for the last ten years consisted chiefly in passing judgment on detail engineering work and in looking up new lines of engineering work for the business. He has had full charge of the financial, engineering and manufacturing interest of the business since 1902.

Mr. Layman is a fellow of the American Institute of Electrical Engineers; an associate member of the (British) Institution of Electrical Engineers; a past-president of the Engineer's Club of St. Louis; past-president of the St. Louis Metal Trades Association; member of the administrative council of the National Metal Trades Association, representing the St. Louis district; a member of the advisory committee of the Winona Technical Institute, Indianapolis; a member of the St. Louis Club, Noonday Club, Mercantile Club, Business Men's League, and Town and Gown Club, a monthly roundtable club of leading professional and business men.

Electric Lighting to Promote Canal Navigation at Night.

The French Ministry of Public Works, Post and Telegraphs has authorized the Chamber of Commerce of Caen, France, to establish and operate a lighting service on the canal from Caen to the sea and on the quays of the port of Caen. This service comprises an electric-lighting installation sufficient to allow navigation at night on the canal.

Electromagnetic Radiation.

At the meeting of the Electric Club, Chicago, Ill., on April 17, an address was delivered by Robert A. Millikan, professor of physics in the University of Chicago, upon the subject "Theories of Electromagnetic Radiation." George C. Keech presided at the meeting and the speaker was introduced by Philip B. Woodworth, professor of electrical engineering in the Lewis Institute.

Dr. Millikan in opening his address pointed out the intimate relation which exists between scientific research and industry and prophesied the still closer interrelation of these, especially in the domain of electrical engineering. He reviewed briefly the ideas which have been held in the past of electromagnetic radiation, pointing out the necessity for the assumption of a material known as ether, which fills all space devoid of matter. The old idea of a wave in which the energy is evenly distributed over the wave front is not sufficient to account for some of the present-day phenomena, and indeed no satisfactory theory now exists. The speaker then pointed out some of the difficulties of formulating a satisfactory theory—difficulties which prevent the explanation of certain phenomena in terms of the older theories.

Lantern slides were shown illustrating the work of C. T. R. Wilson, the British investigator, in photographing the paths of the alpha and beta rays of radium. Similar tracks left by X-rays in traversing the air and breaking its molecules up into ions were also shown. Ultraviolet light also shows the same characteristic of localized energy exhibited by these other rays, and since it has the same character as all other electromagnetic radiation, the ordinary wave theory of this radiation does not account for these experimental facts, and is consequently insufficient.

After extending a vote of thanks to the speaker, the meeting passed a resolution of sympathy with the family of Francis B. Badt, lately deceased.

The Entertainment Committee then made a report recommending that a vaudeville entertainment be given during the convention of the National Electric Light Association in June, to which all the visitors to the city should be invited. An appropriation for this purpose was authorized by vote of the members present.

Illumination of Motion-Picture Projectors.

On Friday evening, April 18, J. F. Martin, of the Duquesne Light Company, read a paper on "Illumination of Motion-Picture Projectors," before the Pittsburgh Section of the Illuminating Engineering Society. Prefacing his remarks with the statement that the aggregate maximum demand of all moving-picture machines in the country is over 60,000 kilowatts, the author pointed out the necessity for an approximately point source of light with as great an intensity as possible, exceeding 10,000 candlepower with a 40-ampere direct-current arc. He then discussed the size and type of carbons recommended for different current values, the lamp mechanism, the lens systems, and the various types of screens.

The principal feature to be observed in the illumination of the hall is the elimination of glare; this prohibits wall brackets, and, in general calls for indirect-lighting systems. The illumination should be graduated from the screen back toward the rear, having an average of 0.3 foot-candle, while at the rear of the hall, where the most movement of crowds takes place, as high as 1 foot-candle is permissible. By using dark-colored walls, the clearness of the picture in not injured.

With flame arcs, a right-angle arrangement of carbons is necessary to limit the area of the light source. Hence the current is limited to about 20 amperes, on account of the magnetic blowout effect of the right angle on the inherently long arc, tending to break it. Experimental metallic flame arcs have given fairly good results, and specially formed tungsten lamps have given good results with small screens.

A motion-picture camera and projector were exhibited and explained.

In discussing whether moving pictures cause permanent eye-strain, Mr. Martin pointed out that the only strain on the eye is confined to the involuntary muscles which control the iris. These tend to close rapidly and open more slowly. Hence the pupil is closed more with a flickering light than with a constant light of the same average intensity, and the pupil may be observed to tremble slightly when watching moving pictures. That the discomfort produced by fatigue from this source is merely temporary is attested by the fact that very few moving-picture operators have any eye trouble.

In the general discussion, which was participated in by Messrs. Hammel, Ward, Lloyd, Riker, and the author, it was brought out that eye-strain is much reduced by better general illumination of the hall, and by the lesser displacement of the picture, produced by the notched film and more perfect register. The principal objection to motor-driven machines has been that the operator may leave the room while the arc is burning. This is discounted by the fact that the operator must constantly watch the pictures to keep them in register, and hence cannot leave for more than a few seconds at a time. Motor-driven machines are permitted by the fire underwriters in Pittsburgh and some other cities provided the film is at no time exposed to the air, also provided an automatic fire shutter is used, and provided the film is rewound automatically as soon as it is used.

At the next meeting, on May 9, a paper on "Train Lighting" will be read by J. L. Minick, of the Motive Power Department, Pennsylvania Railroad.

Utility Legislation in Massachusetts.

Governor Foss has vetoed a bill which the Legislature passed, providing for the extension of the powers of the Cambridge Electric Light Company, to include the selling of steam and other forces and authorizing the company to construct the necessary pipes, conduits, and to install machinery for the purpose.

A hearing was held last week by the Committee on Public Lighting of the Massachusetts Legislature on the bill to codify and consolidate the laws governing the making of gas and electricity as recommended by the Board of Gas and Electric Light Commissioners. Chairman Barker of the Commission advocated the placing of all companies producing electricity for any purpose whatever under the supervision and regulation of the Commission as was advocated by a majority of the Commission in their report to the Legislature, which was set forth in the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 1, 1913. Uniform power over all companies, and a clarification of certain points in existing law, were also advocated. Chairman Barker recounted the great expansion in the hydroelectric industry in the state and the increase in the manufacture of the electricity for power. He predicted that before many years have passed the manufacture of electricity for lighting will bear but a small proportion to that used for power. Mr. Barker urged that the extension of the Board's authority to power companies would strengthen them because of the value it would give their stock as security. Companies which are not now under the Commission's regulation are opposed to the extension of the Board's authority.

Electric Power on the Rand.

A. E. Hadley, of the Victoria Falls & Transvaal Power Company, recently read a paper on power supply on the Rand at a meeting of the Manchester (England) Section of the Institution of Electrical Engineers. The company was formed in 1906, with the objects of supplying power in South Africa and Rhodesia, and acquiring the concessional rights to develop the Victoria Falls for power purposes. The development of the falls was deferred, for various reasons, and it was decided to supply power to the Witwatersrand from steam plants, using local fuel. The great demand for power on the Witwatersrand has resulted from the extraordinarily successful development of the gold mines, which, though they were only discovered in 1886, are today producing one-third of the world's gold supply. The effect of the conversion of the mines from steam to electric driving has been, Mr. Hadley stated, to reduce the cost of power to them by 40 per cent. The peak load of the combined undertaking has reached 88,000 kilowatts, and the average sales are 1,350,000 kilowatt-hours a day. The total amount of the power used by the mines is now about 400,000 horsepower.

Examination for Hydroelectrical Engineer.

The United States Civil Service Commission has announced a competitive examination for hydroelectrical engineer to fill vacancies in this position in the Forest Service and the Reclamation Service, at salaries ranging from $1,800 to $2,400 per annum. Applicants should be qualified to conduct expert examinations on water-power sites, have a theoretical and practical knowledge of hydrology and river hydraulics, and be familiar with the design and operation of hydroelectric plants, as well as having experience in testing, installing and operating them. Applicants must be between 25 and 45 years of age. Examination papers will consist of statements by applicants as to general education and technical training, practical experience and publications or reports. Applications should be made to the office of the Commission, Washington, D. C., on Form 304.

Eastern Pennsylvania Independent Telephone Association Formed.

At a meeting of over 60 independent telephone men held at Harrisburg, Pa., recently, the Eastern Pennsylvania Independent Telephone Association was organized for the mutual benefit of independent companies east of Altoona, Pa. The new association will probably co-operate with the Western Pennsylvania Independent Telephone Association.

The World's Largest Stone-Crushing Plant.

With railroad lines springing into existence in every corner of the globe, with mammoth manufacturing plants being constructed to fabricate iron products, with great skyscrapers climbing to dizzy heights and with huge steel vessels and warships being constructed by all nations, a tremendous impetus has been given to the production of iron and steel. Some of the richest of the iron ore deposits are located on the shores of the Great Lakes, and naturally steel plants of great capacity have been built there at points within easy reach of the mines and yet advantageously located commercially. There occurs also, in this same locality, the largest known deposit of high-grade limestone, thus providing an abundance of material for use as flux in the blast furnaces, 5,000,000 tons of it being required annually for the blast furnaces on the Great Lakes.

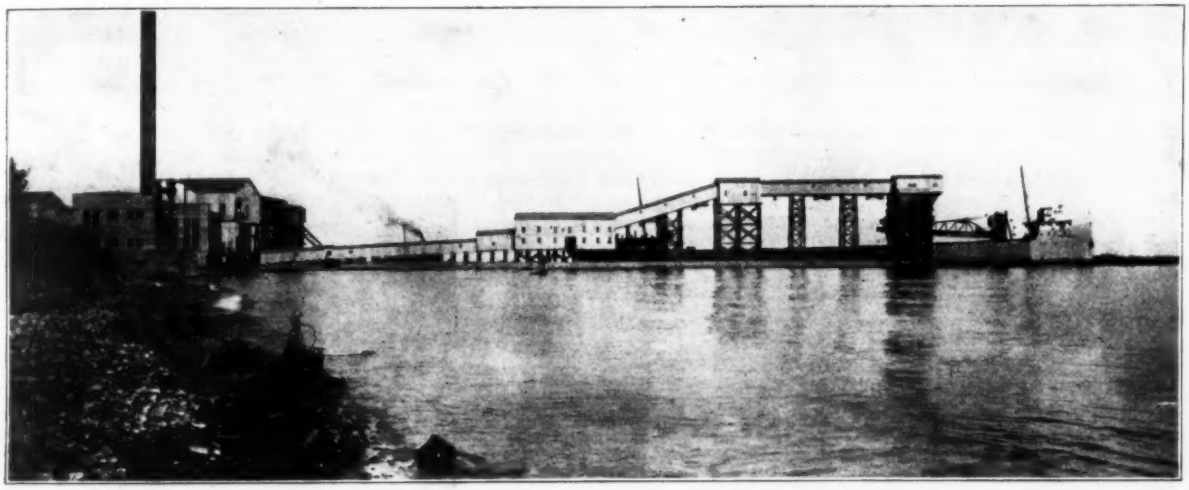


Fig. 1.—Power Station and Pier with Conveying and Loading System.

This deposit of limestone is located at Calcite, in Presque Isle County, in the northeastern portion of the southern peninsula of Michigan, and is owned by the Michigan Limestone & Chemical Company. The rock-crushing plant is electrically driven throughout and illustrates very forcibly the great advantages of the electric drive as compared with other forms of drive in this industry.

The limestone formation at Calcite runs nearly parallel to, and at a short distance from, the lake shore, and the part now being worked is a bluff approximately 40 feet in thickness, the crest having an average elevation of about 70 feet above the lake level. From the bottom of the bluff, the ground slopes in a series of irregular terraces for a distance varying from 500 to 700 feet to the shore line. A track, which can be moved laterally as the work progresses, runs along the base of the bluff and connects the quarry with the crusher house by means of a trestle-supported loop.

The rock, after being loosened by blasting, is loaded into 12-ton cars by two 100-ton Bucyrus steam shovels. Small steam locomotives haul these cars, in trains of seven, to the crusher house, where the stone is dumped into a 42-inch gyratory crusher, the largest of its type in the world. To dump the cars, their bodies are tilted sidewise by a small winch whose steel hoisting cable passes over a pulley on a swinging structural-iron beam located above the track. This winch is driven by a 10-horsepower, 220-volt, alternating-current, back-geared induction motor of the wound-rotor type, the power for its operation being stepped down from a potential of 2,300 volts by two 7.5-kilowatt transformers.

Approximately one minute is consumed in dumping each car and, as soon as the seven are unloaded, the train passes on around the loop, back to the quarry to take the place of a train loaded while it was being unloaded. Train loads of rock are sent from both ends of the quarry so as to make the delivery of stone to the crusher as continuous as possible.

Motor Drive.

For driving the crushers, screens, and belt conveyors the slip-ring type of induction motor with wound rotor and external resistance in the rotor circuit is used. In starting, these machines give 150 per cent of full-load torque with approximately 150 per cent of full-load current and so will start up the plant with the crushers, screens, and conveyors partially or fully loaded without overloading the power station. With three exceptions, 2,300-volt three-phase motors are used throughout, the power being transmitted at this potential for their operation.

The advantage of the electric drive is strongly brought out in connection with the conveyor system. Here 18 motors, aggregating 1,280 horsepower, drive 12 belt conveyors, covering a total distance between centers of end pulleys of more than 2,100 feet. As the various sections of the conveyor system are interdependent, simply passing on what is delivered to them, their operation must be nearly synchronous to be most efficient. This is accomplished with a minimum power consumption by employing individual polyphase induction motors to drive the various sections at a standard speed of 400 feet per second, with the exception of two auxiliary belts in the recrushing section, and by driving through gears or relatively short belts.

Crushers.

The crusher, which, as stated above, is the largest of its kind in the world, has a weight of a half million pounds. It is belt-driven by a 200-horsepower, 2,300-volt, induction motor of the slip-ring type. The average load carried by this motor is 60 horsepower but it varies with the amount and the size of the rock delivered to the crusher, reaching a maximum of 265 horsepower as the heaviest load under normal working conditions. Yet the over-

load capacity of this motor is so liberal that the crusher has been started from a standstill when it was full, throwing a load of 450 horsepower on the motor momentarily, and this load has been safely carried. This motor is not provided with an outboard bearing, yet it has withstood this service since it was first installed.

Conveyors to Screens.

From the base of the crusher, the rock is discharged onto a 48-inch conveyor belt (*A* in Fig. 2), which is 182 feet between centers of end pulleys and has an inclination of 15 degrees to the horizontal. This conveyor has a capacity of 1,450 tons per hour and delivers the stone to the screen house, where it passes over an inverted V-shaped grizzly, which divides the load and delivers it in approximately equal volumes to two inclined rotary screens.

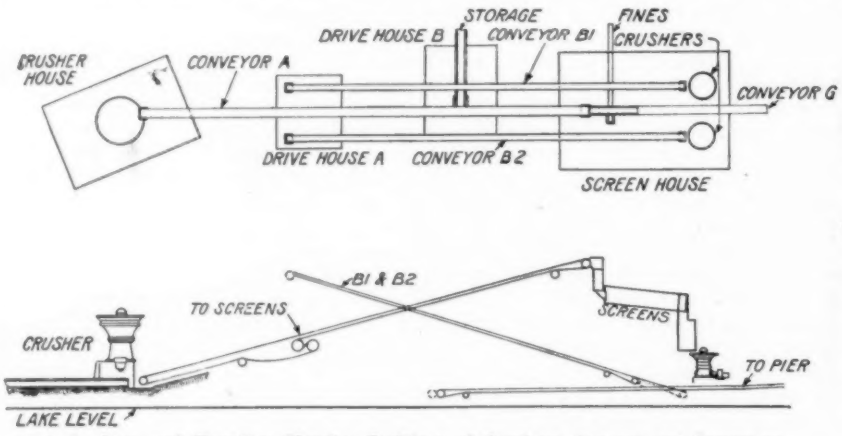


Fig. 2.—Plan and Elevation Showing Positions of Crushers, Screens and Conveyors.

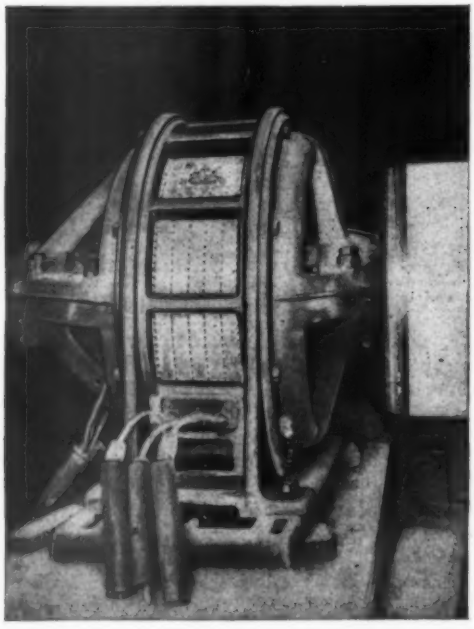


Fig. 3.—Induction Motor Driving Main Crusher—200 Horsepower.

This conveyor belt is driven by a 125-horsepower induction motor, back-geared to the driving pulley of the conveyor.

Screens.

Rotary screens, the largest units of this tpye in operation, each consisting of a cylinder seven feet in diameter and 32 feet long, in which there are graduated perforations, assort the crushed rock. These screens are individually driven by 50-horsepower motors which rotate the screens by means of a belt-driven jack-shaft, the latter operating through direct-connected bevel gearing.

These screens separate the rock into three classes. The "fines" *i. e.*, material which passes through holes less than one inch in diameter—is unfit for flux and so is discharged into a hopper below the screens, from which it passes to a belt conveyor, which runs at right angles to the main conveyor line and carries it to a "fines" bin, from which it is loaded into cars and utilized for filling. This cross conveyor has a 24-inch belt, a length of 140 feet between centers of the end pulleys, a capacity of 250 tons per hour, and is belt driven by a 20-horsepower motor, the load varying with the character of the rock passing through the screens, but not normally exceeding eighty per cent of the rated capacity of the motor.

The rock which passes through the perforations in the second section of the screens varies in size from a minimum of one inch to a maximum of six inches in diameter and is a suitable "flux stone." It is discharged into a bin, from which it is either spouted onto the main conveyor, which carries it out to the pier, or else is delivered to the belts serving the stone storage pile.

From the lower ends of the screens the "oversizes" are fed directly to two small gyratory crushers which are individually driven by 75-horsepower belt-connected motors. From the crushers the rock is elevated by two 30-inch belts. (*B*1 and *B*2, Fig. 2), each having a capacity of 250 tons per hour, to a chute which delivers it again to the conveyor (*A*, Fig. 2) to the screen house, where it again passes through the screens. The belts *B*1 and *B*2 are each driven at a speed of 200 feet per minute by a 20-horsepower belt-connected motor. These conveyors will be discarded shortly, as, by altering the small crushers their output can be delivered directly either to the conveyors running to the loading dock, or to those going to the pile of stone stored for future shipment.

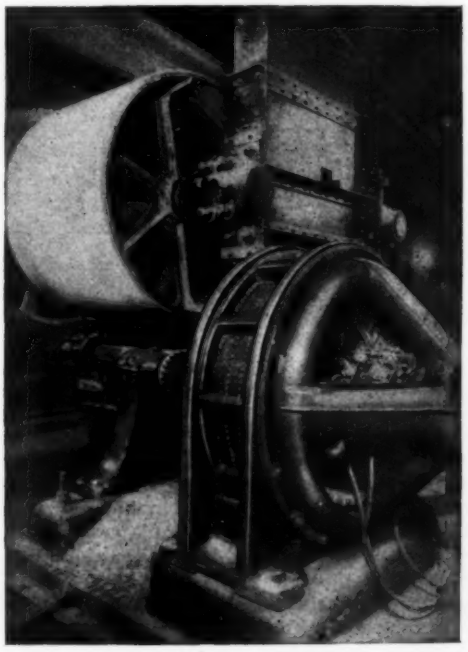


Fig. 4.—Induction Motor Driving Reclaiming Conveyor—125 Horsepower.

Belt-Conveyor System from Screen House to Pier.

The conveyor system for carrying the "flux stone" from the screen house to the loading bin on the pier is divided into three sections, each section

being provided with a 44-inch belt having a capacity of 1,300 tons per hour, the lengths between centers of the end pulleys being 360, 140 and 130 feet. Individual motor drive is employed, two of the motors, of 125-horsepower capacity, being geared to the driving pulleys, while the third, a 35-horsepower unit, is belt-connected.

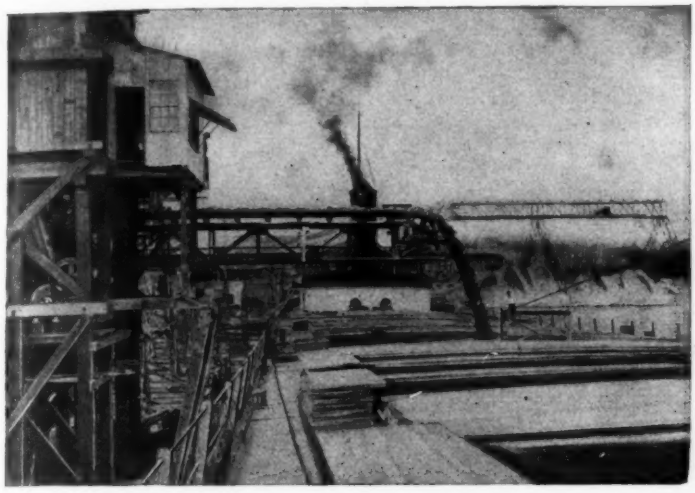


Fig. 5.—Shuttle Conveyor Delivering Stone to Ship's Hold.

In passing over the conveyors along the pier, the "flux stone" is elevated 54 feet and discharged into a loading bin of 500 tons capacity located near the outer end of the pier.

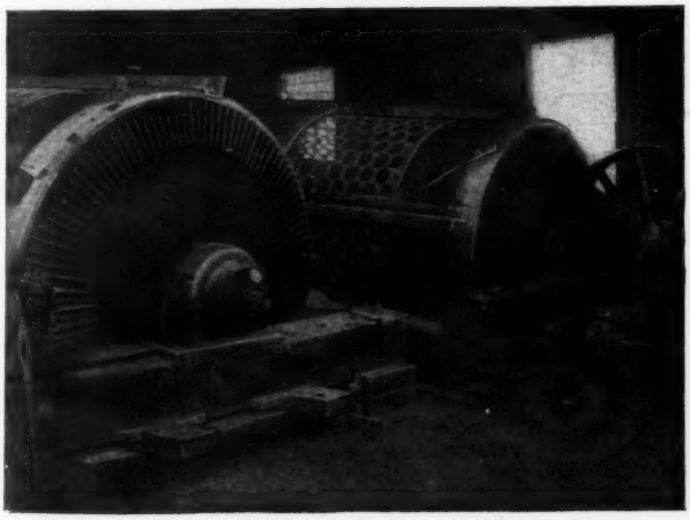


Fig. 6.—Sorting Screens, Each Driven by 50-Horsepower, 2,300-Volt Induction Motor.

Method of Loading Ships.

From the loading bin, the "flux stone" drops through a hand-operated gate onto the belt of a shuttle conveyor, which operates at right angles to the conveyor from the screens to the storage bin on the pier. This shuttle conveyor consists of a structural-steel framework carrying an endless belt 48 inches in width. The framework is mounted on stationary wheels so that it can be moved forward or backward to compensate for varying sizes of hatchways in the different vessels and to make the adjustments necessary for depositing the stone evenly in the hold. This movement is accomplished by means of a drum provided with a steel cable, the ends of the latter being connected to the opposite ends of the movable conveyor framework. The drum is driven by a 20-horsepower, 220-volt induction motor of the squirrel-cage type, installed on a platform just below the conveyor. The belt is driven by a motor of the same type and capacity. The conveyor delivers the stone at an average rate of 1,000 tons per hour, but its maximum capacity is 1,400 tons per hour.

The control of the motors and bin gate is centered in an operator's house located above the conveyor (see Fig. 5) where the operator has a clear view of everything concerned in loading. As the service requires a comparatively low starting torque, the squirrel-cage type of induction motor was selected, current being supplied to the motors from the 2,300-volt feeder line by two 10-kilowatt transformers which step the potential down to 220 volts.

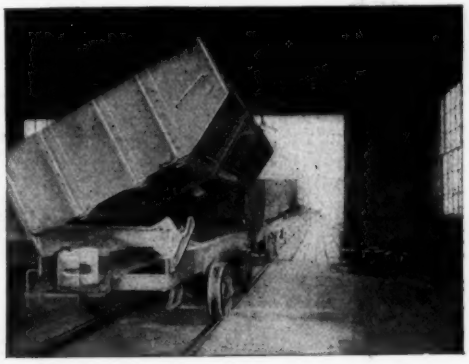


Fig. 7.—Motor-Driven Car-Dumping Hoist.

At present, it takes about six hours to load a 6,000-ton ship, it being necessary to wharf the ship along the pier as the successive hold compartments are filled. Upon the completion of the construction work at Calcite there will be seven additional loading bins, each provided with a shuttle conveyor, and then a 6,000-ton ship can be loaded in approximately two hours.

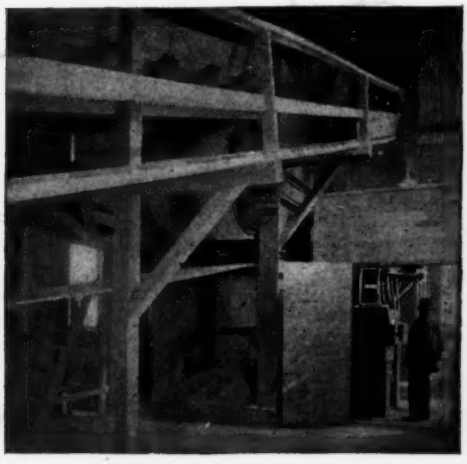


Fig. 8.—Induction Motor Driving Conveyor Belt from Screen House to Pier.

Delivery to Storage Pile and Reclamation.

It is obvious that the loading of the ships cannot be made a continuous

process, as some time must elapse while a loaded ship is clearing the harbor and an unloaded one is being brought alongside the pier. At the same time it is essential that the operation of the crushing and conveying system be maintained without interruption if the maximum efficiency of the plant is to be realized. To render this possible, storage facilities, having a recoverable capacity of 13,000 tons, have been provided.

When the "flux stone" is to be delivered to the storage pile, it is carried by a short belt, 68 feet in length between the centers of end pulleys, to drive-house *B* (Fig. 2), where it is deposited on a cross conveyor, which elevates it at an angle of 15 degrees and delivers it to a conveyor running out over the storage pile at an elevation of 65 feet above the lake level. All three belts are 40 inches wide and have a capacity of 1,000 tons per hour. The short transfer belt is driven by a 35-horsepower, belt-connected motor, while the elevating and delivering belts are driven by a 150-horsepower motor located in a tower at the head of the storage pile and gear-connected to the two driving pulleys where the two belt conveyors come together.

The belt conveyor which delivers the "flux stone" to the storage pile is 190 feet in length between centers of the end pulleys and is installed on a structural-steel bridge with A-frame supports mounted on concrete foundations, the design being such that the running stone does not strike the steel work. A tripping device, operating along the belt, insures an even distribution of material on the storage pile.

A concrete tunnel, which extends under the bridge and parallel to it, is provided with a row of gates in each side near the top. When it is desired to get stone from the storage pile, some of the gates are opened allowing the stone to pass through, where it is deposited onto a 44-inch reclaiming belt, 360 feet long between centers of end pulleys, which runs level in the base of the tunnel. This conveyor carries the stone to the drive house *B*, where it is discharged onto the main conveyor line and delivered to the loading bin on the pier. The reclaiming belt is gear-driven by a 125-horsepower motor and has the same capacity as the main conveyor line, or 1,300 tons per hour.

When the stone is being delivered to the storage pile, the reclaiming conveyor and the pier conveyor line are not in service, and the storage pile is drawn on when the crushing and screening machinery is not in operation; but when the rock is passing directly from the main crusher to the loading bin, none of the motors on the storage system are used. For this reason, the 750-kilowatt turbo-alternator can at all times supply sufficient current for the operation of the plant, although the aggregate rated capacity of the motors on the feeder circuits is greatly in excess of the power station's output.

MOTOR EQUIPMENT.

No.	Horse-power.	Revolutions per Minute.	Drive.	Service.
1	10	...	gear	Dumping hoist.
1	200	600	belt	Large crusher.
1	125	600	gear	Conveyor to screens.
2	50	900	belt	Screens.
1	20	900	belt	Conveyor to dump.
2	75	600	belt	Small crushers.
2	20	900	belt	Oversize conveyors.
1	125	600	gear	G conveyors to H on pier.
1	125	600	gear	H conveyor to H1 on pier.
1	35	900	belt	H1 conveyor to loading bin.
1	20	720	gear	Shuttle conveyor.
1	20	720	gear	Shuttle adjuster.
1	35	900	belt	D1 conveyor to D.
1	150	600	gear	Conveyors to storage.
1	125	600	gear	Tunnel conveyor.

CONVEYOR SYSTEM.

Belts.	Capacity in Tons per Hour.	Width in Inches.	Centers in Feet.	Grade in Degrees.	Speed in Feet per Minute.
A	1450	40	182	15	400
B1&2	250	30	163	17	200
C	250	24	140	17	400
D1	1000	40	68	17	400
D	1000	40	167	15	400
E	1000	40	190	level	400
F	1300	44	360	level	400
G	1300	44	360	20	400
H	1300	44	140	17	400
H1	1300	44	130	level	400
J	1400	48	70	level	400

A—Conveyor from crushers to screen house.
B1-B2—Conveyors from small gyratory crushers to chute to screen house.
C—Conveyor for "fines."
D1, D and E—Conveyor system from screen house to storage pile.
F—Reclaiming belt in tunnel.
G, H and H1—Conveyor system from screen house to loading bin on pier.
J—Shuttle conveyor.

The conditions under which the motors operate vary with their location. Some are mounted on substantial concrete foundations, while others are installed on wooden beams. All are of the open-frame type, and, with a few exceptions, are not housed in, yet they operate sometimes 24 hours per day, in an atmosphere carrying considerable limestone dust. The motors have dust-proof bearings, and are blown out each day with the air blast, so no injury has resulted from the dust. It is planned to provide dust-proof housings with air ducts in top and bottom, thus giving a natural ventilation.

The control equipment for the motors includes controllers, oil switches, and time-limit relays to take care of individual overloads, but no circuit-breakers or fuses are used, as the safety of the equipment is assured by a simple but very reliable emergency system, which controls the motors in two groups and cuts out of service all the units in either group in case a motor is stopped. Each of the two groups of motors is supplied by a separate feeder, one of these supplying the motors on the shore, including those connected with the storage system, while the other supplies the motors on the pier and shuttle conveyor. By means of snap switches located at various points in the plant, or carbon contacts on the motor panels connected across two independent direct-current circuits, the latter being supplied by the direct-current turbogenerator in the power station and therefore uninfluenced by the alternating-current power circuit, the trip coils on the oil switches of either of the feeder circuits may be operated, thereby stopping the motors throughout the section. Thus congestion of material at any one point, due to the shutdown of a motor is prevented. Red lamps, connected across the emergency circuits, remain lighted as long as the power circuits are alive.

As the power is transmitted but a comparatively short distance, the maximum transmission distance being about 1,300 feet, practically no allowance need be made for voltage drop, and so no transformers, except those used with the three 220-volt motors, are required.

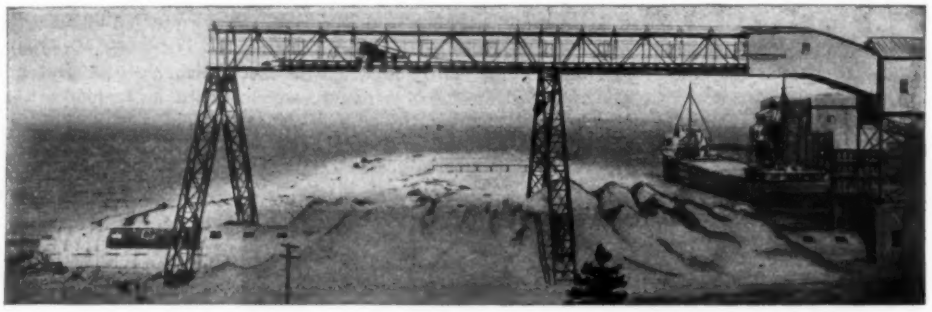


Fig. 9.—Storage Pile, Bridge Carrying Delivery Belt, and Concrete Tunnel Which Houses Reclaiming Belt Conveyor.

Varnished-paper-insulated stranded cable is used, and, except for the tunnel and pier circuits, all conductors inside the buildings are run in iron conduit.

For lighting, both carbon and tungsten incandescent lamps operate on 125-volt circuits, fed from the exciter busses. Ultimately a series incandescent system provided with Mazda lamps will be installed for the illumination of all buildings, yards, roads and steam shovels.

Power House.

The power house is located on the lake shore, about 200 feet south of the pier. The generating units consist of a 750-kilowatt, 2,300-volt, three-phase horizontal Curtis turbogenerator operating at 3,600 revolutions per minute, and a frequency of 60 cycles, and operating condensing at a steam pressure of 150 pounds; a 25-kilowatt, 125-volt direct-current Curtis unit, operating noncondensing and furnishing excitation current for the 750-kilowatt turbine, and also supplying power to the lighting and emergency cutout circuits. There is the usual switchboard in the power house, but at the present time hand regulation is employed. The entire plant is operated 20 hours per day under normal conditions, but the power station is in service continuously. It started up in June, 1912, and since then only one shutdown due to the electrical system has occurred. This was caused by a drop in potential which cannot be justly charged to the electric system as it resulted from the hand method of control which will be superseded at an early date.

Facilities for Shipping.

Since starting, shipments of limestone for blast-furnace flux have been sent by water to Buffalo and Chicago, and under normal weather conditions this service can be continued during seven or eight months of the year. The facilities at Calcite include a slip 1,100 feet long and 90 feet wide with a depth of water at the pier of 21 feet, sufficient for the largest vessels on the Lakes. A stone breakwater, 1,200 feet in length and 80 feet in width, ensures a safe harbor for the ships while loading.

As regards the electrical operation of the plant, it may be said that the effective centralization of the power plant, the good overall efficiency of operation, the simplicity and safety of the power-supply system, and the coordinate operation of all sections of the plant equipment which has been attained at Calcite would have been impossible with any other system of operation.

The Michigan Limestone & Chemical Company assigned the design and installation of the power plant to J. G. White & Company, of New York, the conveying system being provided by the Robins Conveying Belt Company, and the electrical apparatus, and steam turbines by the General Electric Company.

Commercial Practice
Management, Rates, New Business

PURCHASED POWER IN COAL MINES.[1]

By H. C. Eddy.

However sound the abstract theory of the central station as a power merchant may be, its continued existence depends upon its ability, in practice, to supply power on a basis which shall be reasonably profitable to both parties concerned in the transaction.

An analysis of the conditions of use of power in the bituminous coal mines in Pennsylvania and Ohio discloses certain general facts which are decidedly favorable to the purchase of power, when available, as compared with the operation of independent plants.

There are but few mines in these fields that operate more than sixteen hours per day, and many that run but a single shift. The double-shift basis of operation is, however, sufficiently common to be considered typical. The load curve of such a mine shows that approximately two-thirds of the total kilowatt-hours per day of 24 hours, is used between 7 a. m. and 4 p. m., the remaining one-third being used between 6:30 p. m. and 1 a. m. During the day run the demand is quite variable, fluctuating between wide limits for short periods. The widely different conditions existing in the individual mines make it practically impossible to give accurate values to the various elements of load. In one mine the grades may be in favor of the loads to be hauled by the locomotives, while in another case the reverse may be true, tipples may be above or below the level of the mine opening, fan operation may be required continuously at a high rate of air discharge or the reverse. Notwithstanding all these variables, the general characteristics of the total load are quite uniform in being removed from the central-station peak.

The application of alternating-current motors to mine equipment is not general, practically all mines operated by electric power using direct current at either 250 or 550 volts. This necessitates the use of either synchronous converters or motor-generator sets when power is purchased. When the latter are used it is the general practice to specify synchronous motors, on account of the somewhat better efficiency to be obtained, as compared with induction motors, and also for the improvement of power-factor.

The advantages to the central station which justify low prices for mine power may therefore be summed up as follows: the considerable amount of power used; the off-peak load; the extensive application of synchronous motors, tending to raise the plant power-factor, with the attendant advantages.

From the standpoint of the mine operator the advantages of purchased power are more numerous. The most important consideration is that of cost. The essential reasons for a relatively high cost of operation of independent mine power plants are as follows.

The controlling element lies in the load-factor. The daily load-factor is much higher than the monthly ratio, due to the fact that during the month the average number of working days ranges from 15 to 20, due to car shortage, market conditions and temporary labor difficulties. The annual load-factor is even lower, due to the same general conditions, but upon a more extended basis. The result of this condition is that the investment in power plant and equipment is idle for much of the time, and as interest, depreciation and taxes are continuous charges, the result is that the actual output of the plant carries a very high fixed charge per kilowatt-hour.

This condition does not exist when power is purchased, except in so far

1 A paper presented at meeting of American Institute of Electrical Engineers, Pittsburgh, Pa., April 18, 1913, abridged.

as it applies to the current-transforming apparatus. The cost of equipment per kilowatt of capacity being much lower than the cost of complete plant equipment, there is a substantial saving to be effected in this item of power costs.

The actual manufacturing cost, exclusive of overhead charges, under conditions of widely varying load and intermittent use of generating equipment, becomes much higher than would be found with exactly the same apparatus working more continuously.

The individual mine plant is usually located at the least favorable point, considered electrically, i. e., at the mouth of the mine. As the mine is developed the electrical center of the load recedes from the plant location and the losses in the distributing system constantly increase. The extent to which it is advisable to increase the investment in copper to minimize voltage losses can be determined only by a careful survey of the conditions applying to each particular installation.

Aside from the actual copper loss, the low voltage obtainable at the point of delivery of current brings in its wake a high maintenance cost for motors on locomotives and coal cutters, chiefly in the form of armature and commutator repairs. These troubles are directly traceable to the abnormal volume of current required by reason of less than normal voltage. Aside from this actual expense there is the loss of possible output due to reduced capacity of motors, brought about by the unfavorable conditions of current supply. This loss is far greater than the actual cost of repairs and its magnitude is often unappreciated by mine operators.

These conditions may be remedied to a great extent, if not practically eliminated, where power is purchased, by placing converters or motor-generators so that the mine distributing system may be fed at several points, thus materially reducing line losses, equalizing line voltage, and bringing it up to the normal working voltage of the motors in use. As the mine is developed and new conditions arise with respect to the distributing system, the location of the conversion equipment may readily be changed. This flexibility is impossible with a complete steam plant.

In any successful concern the growth of its operations is ordinarily greater than originally expected. The coal-mining industry is no exception to this general rule, and operators are periodically faced with the proposition of extending and enlarging individual plants to meet the greater demands for output. Usually this problem is solved by adding boilers, engines and generators, with a resulting greater investment of capital than would be required by the addition of a motor-generator set. The capital invested in plant equipment in excess of the cost of motor-generators would earn much more per year, if put into strictly mining machinery.

The operators of mine plants are ordinarily handicapped by the character of labor available for power-plant operation. In some cases mines are so located with regard to living conditions that really skillful engineers may be obtained and kept. In more instances, however, the conditions of work and locality of the mines do not prove attractive to the best men except as a temporary expedient. As a natural result the average mine plant receives less than an ordinary amount of skilled attention, when, by reason of the severe conditions under which it operates, it should receive more. Under such circumstances it is to be expected that the cost of maintenance will be high.

Where power is purchased the care required by conversion apparatus does not call for an expert man in constant attendance. The ordinary daily care required may be furnished by the necessary switchboard operator. In some cases this duty can be safely assumed by the repair-shop men, thus eliminating entirely any cost for attendance.

It is obvious that the employers' liability hazard, so far as power supply is concerned, is greatly reduced when power is purchased.

The advantages gained by the mine operator by the purchase of power are direct and may be summed up as follows: reduction of fixed charges on investment; reduction of actual operating costs due to the fact that only power used is paid for, without stand-by charges due to intermittent operation, and by reason of the higher efficiency of electrical apparatus at any load, as compared with steam generating equipment of the character available for mine work; material reduction of distribution losses; a considerable increase in the output of mining machines and locomotives due to maintenance of speed through normal voltage; flexibility of location of motor-generators, enabling them to be placed at points giving the best operating results, and to be readily and cheaply moved as conditions change; reduction of labor costs for attendance; elimination of high maintenance, repair and replacement costs for boilers, piping and engines; reduction of cost of superintendence, enabling the mine superintendent to devote his entire attention to securing output; reduction of liability; insurance against constantly increasing power costs, through term contracts at fixed rates; additional coal available for sale.

CENTRAL-STATION POWER FOR COAL MINES.[1]

By C. W. Beers.[2]

The purchase of central-station power by coal operators for use in and about the coal mines appears paradoxical owing to the apparent cheapness of fuel at the mines, yet some companies have found it economical to do so, and up to the present time these companies do not regret making contracts for the purchase of power. One large coal company in the anthracite field has closed a contract with a large central station for a long term of years, and with considerable advantage to itself.

To correctly understand the reasons why a large producer of anthracite should find it economical to purchase central-station power, it is necessary to have a clear understanding of the ordinary steam production, and the uses to which it is applied in and around the various collieries.

About eight or ten years ago, the writer was discussing with the mechanical engineer of a coal company the seemingly large amounts of steam used in various collieries, as the cry of the colliery people was constantly for more steam, although the installation of new steam-consuming devices was in no way proportional to the constantly increasing amount of steam generated.

The mechanical engineer in reply advised that it was simply a waste of money to install more boiler capacity, and made the remark that the surest and best method of increasing the boiler plant capacity was to get busy with the pumps and engines, meaning that if the pumps and engines were kept in suitable repair, or rejected, and an entire new outfit substituted, that the existing boiler plants would be largely in excess of the actual steaming capacity required, and would operate with better load-factors with a consequent reduction in steam expense. A statement of this kind, coming from a liberal-minded engineer, is the pure unadulterated truth.

There are old-fashioned pumps in the mines today working on 24-hour service that apparently fill the bill regardless of the fact that they can digest easily 160 pounds of steam per water horsepower. Pumps on long duty service are seldom touched on account of the time necessary to make suitable repairs, and when repairs are made the question is not how economically will the pump operate, but rather, how

1 Paper presented at meeting of American Institute of Electrical Engineers, Pittsburgh, Pa., April 18, 1913, slightly abridged.

2 Electrical engineer for the Lehigh Valley Coal Company, Wilkes-Barre, Pa.

short a time will it take to make repairs? One can imagine in what condition the cylinders, pistons, valves, etc., are in, and with tight packing and a poor water end it is not a hard problem to guess where a great deal of the steam goes.

The same is true of engines. There are fine specimens of old-time workmanship and material in service 8,760 hours per year. Fans usually must be kept running at any cost, and owing to the inability to shut down the engines to make necessary repairs, the pistons, rings, and valves become badly worn with the result that large quantities of steam are used. More than one fan engine shows 90 pounds of steam per indicated horsepower. These statements are advanced to show the condition of much of the machinery in use today. Colliery operations are usually conducted with the idea of getting maximum coal output, and little attention or money is spent in keeping the machinery in repair so that it may work at maximum economy.

A great source of loss in the present colliery steam plants today is in the boilers themselves. This is due to the fact that the firemen employed are not very intelligent and their wages are not particularly high. The result is that while fuel is comparatively cheap, little effort is made to use it economically; oftentimes the grates are ill adapted for the kind of fuel used and this is due to the fact that the fuel varies largely in quality from time to time. Draft arrangements are not always suitable, with the result that much energy goes up the stack. The boiler units are usually small in size, working at large overloads, and no arrangements are made to have them operate at their highest efficiency.

Long steam lines poorly designed are responsible for much waste of steam. Leaks are seldom repaired, and owing to exposed locations the pipe covering is usually in bad condition.

It is a conservative statement to say that for every effective horsepower-hour used in and about the coal mines, 25 to 30 pounds of fuel are burned under the boilers.

During the last eight years the average value of the fuel used under colliery boilers has increased in value from 35 cents per ton to 75 cents per ton and it is still advancing.

Today, an ordinary boiler plant of 700 to 1,000 horsepower, rated capacity, has a steam cost of approximately 15 cents per 1,000 pounds of steam generated. This figure drops to about 12 cents per 1,000 pounds in plants of 3,000 boiler horsepower.

The constantly increasing cost of steam is a condition that the operator is beginning to appreciate, and as a result he is looking for a cheaper form of power. The large savings introduced by the original small electric haulage plants proved suggestive, and as a result many collieries today are electrically operated in whole or in part.

The correct design of a modern plant for colliery operation is a rather difficult task, and it requires that the future of the mining operations be clearly forecast. This is an exceeding difficult thing to do, and as a result, the tendency is to curtail the initial expense as much as possible.

This is good practise, and the engineer being eager to show good economy installs apparatus that permits of a good load-factor on the plant, and as a result shows low cost of power at the switchboard. As soon as the plant is loaded, additional apparatus must be installed. The station then will operate at a reduced load-factor for some time, although there has been no reduction in the steam expense; hence the cost per kilowatt-hour has naturally increased.

This method produces a variation in the kilowatt-hour cost from time to time and may result in the ultimate installation of five or six machines in the plant. Idle-time periods and idle hours during the working day require that some machines work at underload and this with full steam capacity on the boilers, hence the load-factor naturally decreases, and as a result the average kilowatt-hour cost is fairly high. This condition must be so since the boiler plant does not show a proportionate decrease in cost of steam as the load falls off. The continued acquisition of generating capacity along these lines ultimately results in a high cost per kilowatt installed.

The cost per kilowatt installed for a mining plant of two 500-kilowatt turbo-generator units was found to be $110.07. This included superheaters and stokers. The plant operation was based on a 50-per-cent load-factor. The estimated fixed charges per kilowatt installed are shown in Table I.

TABLE I.

	Installation cost per kilowatt	Fixed charges per year
5 per cent interest on station cost	110.07	5.50
10 per cent depreciation and repairs on machinery	37.70	3.77
5 per cent on switchboard	3.00	.15
10 per cent on lightning arrester	.30	.03
10 per cent on superheater	4.80	.48
5 per cent on buildings	6.00	.30
10 per cent on coal and ash-handling devices	5.00	.50
5 per cent on boilers	42.00	2.10
Boiler repairs (800 horsepower at $2.25 per year)		1.80
50 per cent depreciation and repairs on condenser (mine water)	3.20	1.60
5 per cent depreciation and repairs on steam piping	2.00	.10
10 per cent on feed-water heater	1.50	.15
2 per cent taxes and insurance on plant cost	110.07	2.20
Superintendence, etc.		.32
Total		$19.00

On a basis of 50-per-cent load-factor we would have the following operating cost per year per kilowatt:

Fuel at 75 cents per ton	7.62
Boiler-room attendants	3.42
Power-house attendants	2.00
One general electrician, one-half time	0.75
Oil, waste, etc.	.20
Water	2.12
	$16.11

From these figures it will observed that there is a constant fixed charge of $19.00 per kilowatt installed which is a constant, regardless of the load on the plant. On a basis of 50-per-cent load-factor there is a yearly charge estimated at $16.11.

At this point in the argument it is well to consider these values. Under the item of fixed cost the values of depreciation and repairs may be considered high. This is not the case. It must be remembered that the plant is installed as a mining plant to suit mining conditions, and not a main central station in some city. The care exercised in preserving efficiency, etc., is in proportion to the intelligence of the help employed, hence the plant may be considered to depreciate rapidly.

The operating costs are the real bones of contention, and their estimate is simply a guess. It is at this point that many fail, simply because of the high value of the load-factor assumed.

The investigation of a mine load shows that on account of hoisting, locomotive, and other variable power service, the load naturally varies largely in a plant of the above rating, the variable load being such as to cause the generators to be temporarily overloaded many times during the day. Also, for many periods during the day they are run at underloads, and neither condition tends toward the best economy, although the load-factor based on the kilowatt-hours generated may be fairly high. The result is that a large portion of the kilowatt-hours developed is on ascending parts of the water-rate curves of the prime movers, and hence, we approach a condition of good load-factor on a reduced steam economy.

Another condition that tends to destroy the calculated load-factor is the idle-day periods, and, when pumping must be taken care of, the absence of large quantities of water. It is estimated that 105 days per year are idle days, and naturally on these days the load-factor is not nearly so good as on the regular working day, and par-

ticularly is this true if pumping is not required during a part of this time. The fixed charge of $19.00 still keeps on working silently and so does a large portion of the $16.11 due to operating expenses. The only items of this charge that show any real decrease are the coal and water. Therefore, we see that while it is possible to estimate the average kilowatt cost per year at a total of $35.00 or $0.008 per kilowatt-hour on a basis of 50-per-cent load-factor, there are other things at work that are likely to change this figure considerably.

Some years ago a large central station of 40,000-kilowatt ultimate capacity located in a mining region, endeavored to interest the company by which I am employed in central-station power, but lack of understanding of mining conditions on the part of the central station always interfered.

Finally it became apparent if the power company could be induced to sell to the mining company at a rate not exceeding eight mills per kilowatt-hour on a 50-per-cent load-factor basis, that the proposition would be a fine solution to the above perplexing questions, and it was with this idea in view that the mining company ultimately took up the consideration of central-station power in earnest.

A close study of colliery conditions, such as the expected load-factor, periods of high and light loads, peak loads, etc., indicated that if a complete understanding of conditions could be made clear to the power company a contract advantageous to all parties concerned would be considered. Later a contract was executed to the satisfaction of all concerned, in which the charge per kilowatt-hour was based on load-factor only.

Before the contract was signed the following points were taken up and thoroughly discussed: (*a*) On what basis current would be paid for. (*b*) Territory to be covered by the contract. (*c*) Location of meters for registering the power consumed. (*d*) Delivered voltage, power, and point of delivery. (*e*) Maximum-demand charges. (*f*) What apparatus should be considered as connected load and the method of rating the same. (*g*) The included rating of apparatus used intermittently. (*h*) The method of determining load-factor. (*i*) Pole-line charges—co-party lines. (*j*) Power-factor. (*k*) Explanation of terms used. (*l*) What constitutes a substation.

The discussion of each of the above topics brought out the following arguments for their adoption, and at the same time illustrates the items that should be considered in any contract between a central station and a mine operator.

(*a*) Current could be paid for either on the straight maximum demand basis plus cost per kilowatt-hour, or on a varying rate depending on the load-factor. The latter plan was argued and adopted, because it is a simpler method of handling all charges. It eliminates errors to wrong reading of graphic meters, and hence prevents argument as to the demand. To the ordinary mind, it presents the idea of cheaper rates in a clear manner than rates based on the demand system, as the only point to be observed is that the greater the load-factor the less the rate; whereas the straight demand system has a tendency to curtail consumption due to the fact that the demand power may at times be cumulative, and hence the operator may feel worried as he sees the increase on his demand chart, although his kilowatt-hours may not increase.

(*b*) The contract to be of benefit should be made to cover all territory that a private mining plant could ultimately cover in order that maximum results in load-factor would be obtained.

(*c*) The preferred location for meters should be on the secondary side of transformers. This is not absolutely necessary if the central station installed the meters. In any event they should always be located in the consumer's substation.

(*d*) In this case the power company agreed to deliver direct into the customer's substation, consequently it seemed fair and equitable to permit the power company to deliver the power and voltage from its nearest available lines.

(*e*) Under (*a*) it was decided to use a sliding rate per kilowatt-hour rather than a charge based on maximum demand. On what would the maximum demand be based? Certainly not on the momentary maximum starting loads of motors, as the starting peaks of motors would scarcely be noticed on the load curve of a station of 40,000 kilowatt-average; neither could a two- or three-minute peak be used on account of the difficulty of properly analyzing curves for such a time limit, as errors would naturally be introduced by the thickness of the line; neither could a five-minute peak be used, because this would tend to eliminate hoisting and this would be unfair to the central station, as much hoisting is done on a one-, two-, or three-minute basis. To settle this question the central-station officials visited many plants in the mining regions, and found from actual observation that the rating of the connected load was just about twice the average maximum demand that occurs on the plant. Hence for the maximum demand a figure was used that was equal to one-half of the total connected load.

(*f*) Connected load consists of all direct power-consuming devices (no transformers, converters, motor-generator sets, etc.) and is equal to the sum of the name-plate ratings. Direct-current hoists and locomotives to be rated on one-hour nominal rated basis. Alternating-current hoists to be rated on their continuous basis.

(*g*) Suppose reserve equipment such as pumps should be installed to give protection in time of floods. This equipment would be in service only a few weeks per year. It was considered equitable to include this apparatus only for the month during which it was used.

(*h*) The method of determining load-factors is as follows. Let the total name-plate rating of apparatus used during the month equal 500 kilowatts and let the total kilowatt-hours used during the month of 30 days equal 72,000; then the maximum demand is equal to 250, and the average demand is equal to 72,000 divided by 30 times 24, equals 100; 100 divided by 250 equals 40 per cent, which is the load-factor.

(*i*) If the coal company should require the power company to build a power line expressly to reach a substation, then it seems fair and equitable that the power company should be paid a charge on this line that will represent a total investment charge on the lines. However, if the coal company uses power of a value in excess of this investment charge, then no pole-line cost shall be included in the monthly bill, but if no power is used then the full investment charge is to be paid. This service was fixed at 15 per cent of the pole-line cost.

(*j*) At all times it is to the interest of the coal company to have the proper voltage. The installation of considerable amounts of induction machinery tends to destroy this feature, and may cause trouble to pumps, fans, and hoists, hence to protect itself it is good policy on the part of the coal company to use power-factor correcting devices judiciously.

(*k*) In order that no errors in calculations in load-factors, etc., could arise through ignorance, the power company considered it advisable to make use of definitions that clearly explain the following terms: maximum demand; name-plate rating; load-factor; day.

(*l*) To suitably define the word substation it was determined that all operations that could be conveniently grouped under one colliery lease should be known as a substation.

From the above discussion of the elements of a power contract it is seen

how essential it is that the central station should be made to thoroughly understand colliery operations and the conditions relating to connected loads, and in addition they should be made to appreciate the fact that the day load is highly desirable, and when the night loads occur they are usually of the constant-duty kind.

The company with which I am connected has been operating on central-station power for about one year, and up to the present we have about 1,000 kilowatts connected load consisting of fans, pumps, hoists, locomotives and heaters. Plans are now under way to remove the present boiler plant and operate entirely by central-station power.

Since operating on central-station power, a number of features have presented themselves that make it look like a very satisfactory arrangement. They are as follows: (1) Our average kilowatt cost is lower than the estimated kilowatt charges in the ratio of about 7.5 to 8, and this kilowatt charge is based on delivery at our substation meters, and not at the main switchboard as per the original data. (2) The company is more ready to consider additions to its power equipment due to the fact that power-plant costs have been entirely eliminated and do not appear in the estimate. (3) There is always a readiness to serve on the part of the central station and this is seldom true of the mining power plant. (4) There is absolutely no worry due to power-plant operation. (5) In case of holidays, etc., the monthly bill will decrease slightly, which would not be the case in those plants operated by the mining company, for in such plants labor and fuel decrease but little. (6) As electric operations are increased, fewer demands are made on the colliery boiler plant, with the result that coal will be sent to a ready market which otherwise would be burned under the boilers, and ultimately this will be no small amount of fuel. (7) The use of central-station power affords a remarkably cheap method of reaching isolated banks, and isolated pumping problems. Operations such as small washeries are more or less temporary in character, and can be advantageously worked without causing the distress that might be occasioned when operated from a mine station. (8) The service is reliable. Our service up to the present time does not total more than 15 minutes' delay due to failure of supply and these failures were directly due to lightning. (9) The effect of efficiency is not particularly noticeable, hence air gaps can be made larger, which is highly desirable in mining apparatus.

Electrical Construction

RESIDENCE WIRING.

Installation in a Brick Building Having Concrete Floors.

In order to make the best job possible of the wiring of any given building the electrician who puts in the installation must get a fairly accurate notion of how the building is constructed before he undertakes the electrical work. Similarly, it is easier to follow a description of an electric wiring installation when one has in mind the character of the structure in which the circuits and apparatus dealt with are located. The electrical work with which the following notes are concerned is an installation in a modern residence building. The outer walls are built of brick, and the partitions of hollow tile. The basement floor is of concrete, and the other three floors are laid on concrete. Fig. 1 is a cross-section of a part of the first floor above the basement. Fig. 2 indicates the construction of the second floor. The construction of the third or top floor is essentially the same as that of the second floor. The tile construction in the partition walls is brought out rather clearly in Figs. 4, 5, 6 and 8, these photographs having been taken soon after the installation of the conduits for the electric circuits was begun.

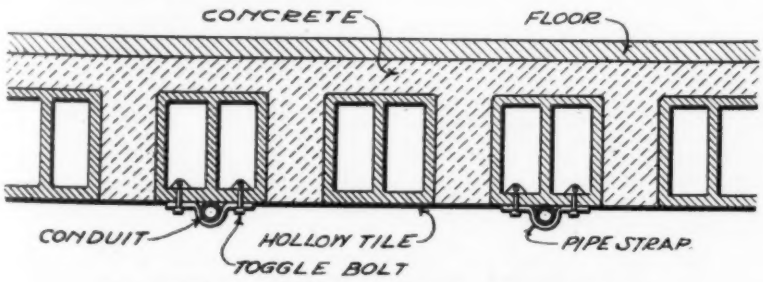


Fig. 1.—Method of Installing Conduits on Basement Ceiling.

The first floor was built by pouring concrete on wooden forms between beams or girders made of hollow tile, the floor proper being laid on a filling placed on top of the concrete slab when the building was almost finished. In the erection of the other floors arches made of corrugated sheet iron were substituted for the tile girders. These arches, shown in section, are marked *A, A* in Figs. 2 and 3. Metal lath was laid on the form as a support for the ceiling plaster. It is understood, of course, that the wooden forms were removed after the concrete had set.

From the foregoing, the practical electrician will readily see that the installation of a high-class job of concealed wiring in the building under consideration was an undertaking requiring careful attention and no small amount of skill. A fact that makes the work even more interesting, perhaps, is that, in placing the contract for the wiring, the owner of the building made quality of construction, rather than low cost, the first consideration, and that no pains were spared to secure the best sort of installation for complete electric service in the home.

Bond Brothers & Company, of Evanston, Ill., were the electrical contractors on this building, which is located in one of the suburbs of Chicago.

Installation of Circuits for Light and Power.

Except where steel-armored cable was specified for extensions to outlets at dressing cases, or to other outlets similarly situated, rigid metallic conduit of the loricated type was used for all lighting and power circuits. As is customary where wiring is properly done, the ends of all pipes were carefully reamed before the pipe was in-

stalled. The Code specifications that no bend in a pipe may have a radius of less than three and one-half inches and that there must not be more than the equivalent of four quarter bends from outlet to outlet were followed strictly; and in no case were couplings and connections used in bends in a conduit. All branch circuits were run in what is known as half-inch conduits, the actual inside diameter of such pipes being, as wiremen are aware, something like 0.62 inch. The largest conduit used is inch and a half, nominal size.

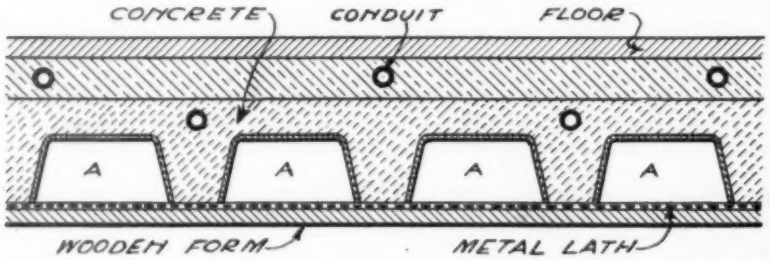


Fig. 2.—Conduits in Concrete Floor Slab and in Filling Between Slab and Floor.

All ceiling outlet boxes are of standard design, and of the Sprague type. Wherever it was impracticable to install a box at a ceiling outlet, an outlet plate was employed. To secure the ends of the conduits to outlet boxes and plates, and to cut out cabinets, pull boxes, junction and switch boxes, approved locknuts and bushings were used, of course.

Before speaking further of the fittings and materials used in this job, it will be well to consider briefly the methods employed in the installation of some of the conduits. In vertical runs on brick walls the pipes were supported in the usual manner, while in partitions either hollow tile was threaded over conduits or else recessed blocks of tile were used to build up the wall around the conduit. The basement circuits were installed in exposed conduits fastened to the tile girders with pipe straps and toggle bolts, as shown in Fig. 1. The heavy line at the bottom of this figure indicates the position of the wooden form, which was torn away after the concrete had set. In the second and the third floors part of the conduits were run before the concrete floor slab was poured, these pipes being used for circuits to outlets in the ceiling of the room below. For other outlets pipes were laid on top of the poured slab and these covered with the filling on which the floor itself was placed. Sectional views of the two sets of conduits are included in Fig. 2, and some of the accompanying photographs show portions of the conduit which were covered with the filling on which the floor was laid. Where runs of pipe extend across the iron arches marked *A*, *A* in Figs. 2 and 3, the construction was similar to that shown in Fig. 3 for such circuits as feed ceiling outlets. The wooden blocks laid on the sheet-iron arches to hold the conduit well up in the body of the floor slab were knocked out before the pouring of the concrete reached the block, however. The figure shows one outlet box in place between two of the arches formed of sheet iron, and another installed under one of these arches.

If the conditions were not such as to make it impossible, each run of conduit in the concrete was inclined slightly toward an outlet, so that it would drain.

Where there is more than one flush switch at any location, the switches were installed in sectional switch-boxes. In all groups or gangs of switches at a flush-switch outlet, the switches are arranged in vertical gangs; that is, one switch is placed directly above the other. A reason for adopting this sort of grouping was that it made a better looking construction with the kind of paneling employed on the walls than could have been obtained by placing switches side by side in horizontal rows. Some groups contain as many as six flush switches. One of the sectional switch-boxes is shown in the left-hand side of Fig. 5, and another at the left side of the door frame in Fig. 6.

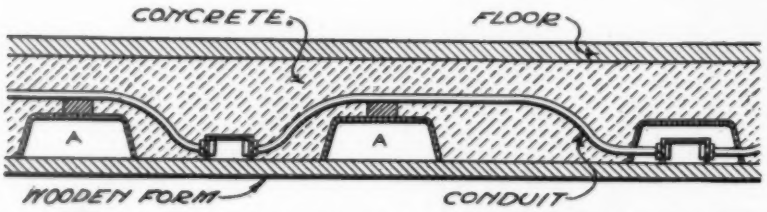


Fig. 3.—Method of Installing Conduits and Outlet Boxes Where Conduits Run Transverse to Sheet-Metal Arches.

The architect's specifications on this job of wiring only required that the Code rule calling for fuses, on approved fuse bases, wherever there was a change in the size of the wires of the circuits be fulfilled, and hence in the bid of the electrical contractors who got the job no allowance for the cost of distributing panel-boards and cabinets for them was included. But these contractors put in a high-class panel-board where it was needed, anyway. When asked about this, a member of the firm of contractors remarked that his firm regarded a pleased customer as one of its best assets, and that it found that in order to please its customers good work must be done. It was seen that the use of two panel-boards in standard cabinets would add greatly to the installation, and therefore they were put in.

Fig. 4.—Conduits to Partition-Wall Outlets Before Partition Was Built.

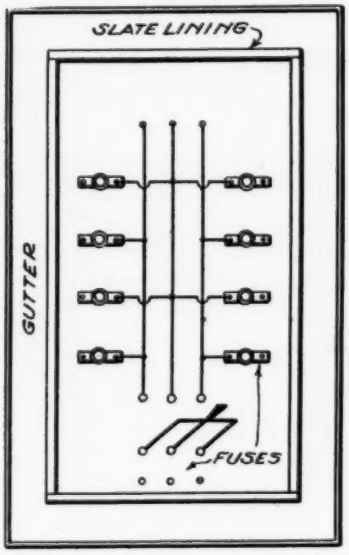
Although the distributing panels just referred to are of a well known stand-

ard type, a word in the way of description of them may not be out of place. These panels consist of slate-lined sheet-steel cabinets in which the feeder switches and branch-circuit fuses are installed. Fig. 5 is a front elevation and a sectional view of one of the cabinets. Outside of the box containing the fused three-pole switch and the branch-circuit plug fuses, between the walls of this slate box and those of the steel cabinet, are gutters of ample dimensions for the wires. The feeder circuit enters from the bottom, and the branch-circuit wires are carried out through holes in the side walls of the slate lining, and then run to conduits which leave the inclosure at either the top or at the bottom, whichever happens to be most convenient. The front cover of the wiring gutter consists of wood trim lined with thin sheet metal, the outer finish of the wood trim being made to conform to the finish of the surface of the surrounding wall of the building. The door of the cabinet is made of glass.

Fig. 5.—View of Conduits in Second-Floor Room Before Floor Was Finished.

Fig. 6.—Another View of Partition-Wall Outlet and Switch Boxes.

In Fig. 9 the relative positions of the cutout cabinets are indicated. The three-wire service enters the basement underground, and is brought to the metal box containing the service fuses and switch. Then, from the service cabinet, a 1.5-inch conduit runs along the basement ceiling to a point under the location of the distributing cabinets, these being installed one directly above the other, one on the first floor and the other on the second, at convenient points on these floors. The conduit for the feeder from the first-floor cabinet to that on the next floor up is a one-inch pipe. Extending downward from the cabinet on the first floor there is a one-inch conduit containing



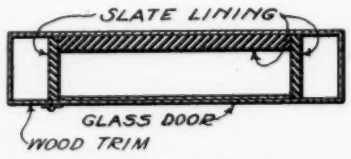


Fig. 7.—General Plan of Distributing Cabinet.

circuits for the vacuum-cleaner motor and for the basement lights, which pipe runs to a pull box from which half-inch tubes radiate to the various outlets in the basement. As has been stated already, the standard practice of using half-inch conduits for 660-watt circuits is, in general, followed throughout the job. But a number of the branch circuits leave the distributing panels in pipes larger than this, the reason being that more than one circuit is run in the same conduit. In such cases a three-quarter-inch conduit was usually run to a ceiling-outlet box conveniently located, and two circuits pulled into it. From this outlet box to the outlets to be served, each circuit was run in its own pipe. This was considered better construction than to run a larger number of smaller conduits.

It should be noted that in Fig. 9 the short pieces of conduit extending vertically upward from the first distribution cabinet are portions of the pipes which are concealed in the second floor. The pipe extending toward the right just above the service cabinet is the one containing the circuits for the basement.

Distribution and Control.

Enough has been said already, no doubt, to give one a fairly complete notion of the layout of the circuits in the installation under consideration. It may be worth while to add, though, that the feeders from the service cutout to the first center of distribution consist of three No. 2 B. & S. gauge wires; that from here to the second-floor cabinet three No. 6 wires run; and that 16 branch circuits radiate from

Fig. 8.—Outlet Box Set in Tile Wall.

the cabinet on the first floor and 12 from that on the second. In quite a few instances, however, the number of sockets per circuit is less than the maximum sanctioned by standard practice. Circuits were left only partially loaded in order to simplify the matter of making extensions which may be called for in the future. To run an extension from a nearby outlet box in a completed building of this type may not be too difficult, but to run a branch circuit all the way from the distributing cabinet might easily prove altogether impossible.

There has been some reference already to the methods of installing flush push-button switches where these are grouped two or more in one switch-box. As a further note concerning the switches and the control of the current in the various circuits, it may be mentioned that the current can be cut off of the entire building either at the service cabinet in the basement or at the distributing cabinet on the first floor, by means of the three-pole knife switches installed there, while, at the second-floor cabinet, the current can be turned off from the second-floor and the attic rooms above by opening the three-pole knife switch in this inclosure.

There is a generous use of three-way and of four-way switches throughout the residence. For example, for controlling the hall and stairway lights there are a three-way switch on the third, and an intermediate four-way switch on the second floor. Such an arrangement makes it possible, of course, to turn the lights on all three floors on or off simultaneously, at any time, independently of the switches on the other floors. Lamps at certain entrances to the building can be lighted at will either from the outside or from within the house, two three-way switches having been provided whenever it was desired to control an outlet in such a manner.

An especially interesting arrangement is that employed in the operation of the vacuum-cleaner motor. The motor switch itself is located near the motor, in the basement. But this is a switch which is held closed by the magnetic pull of a solenoid, and the circuit supplying the current for energizing this solenoid runs past all points in the house, and in the garage on the grounds near by, as well, from which it might be desirable to start up the vacuum cleaner, at which points there are switches in this circuit. These are all push-button flush switches, mounted in standard switch boxes. The connections are such that the vacuum cleaner can be started from any one of them, but it cannot be stopped from one switch as long as a switch at some other point is closed. Each switch box contains a small incandescent lamp, and the flush plate which covers the box has a small circular glass window, or bull's eye, set in it, at one side of the push buttons. The lamp burns as long as the switch is closed, and so the glowing of the bull's eye shows that the vacuum-cleaner motor is running. The lamps at no other switch burn in the meantime, unless somebody inadvertently closes another switch, in which event the lamp there will also burn until this latter switch is opened. This switching device was supplied by the Bryant Electric Company. A similar indicating device is used on all electric heater circuits, of which there are a number in the house.

Telephone and Bell Wiring.

There is a house-telephone system that includes eight telephones. These are located at convenient points in rooms and hallways, and are so arranged that from any station any other station in the system can be called by the person who wishes to talk. The telephone circuits are run in standard conduit.

The servants' quarters are equipped with call bells and an annunciators, and circuits from these run throughout the house, to numerous push buttons installed at points convenient to the occupants.

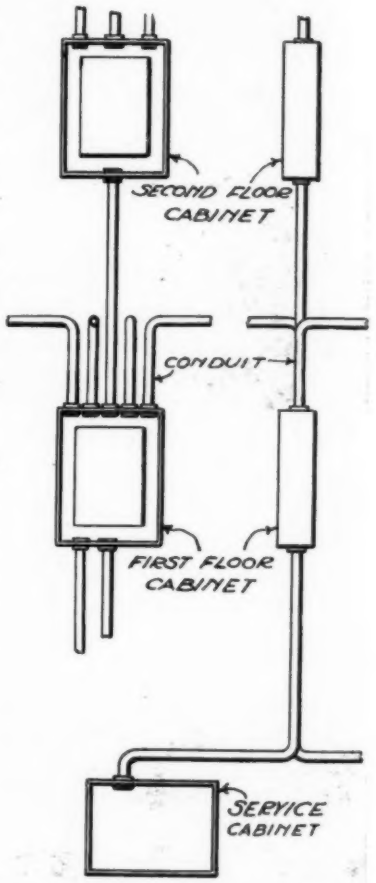


Fig. 9.—Front and Side Views of Cabinets and Conduit Risers.

The bell circuits are all in half-inch conduits. The circuits are made of No. 18 rubber-covered fixture wire.

Other Notes on Equipment.

It is hardly necessary to add to the foregoing notes any further comments as to the nature of the electrical equipment in this residence. As has been suggested, it is quite complete. It includes a modern type of vacuum cleaner, a centrifugal fan for removing odors and gases from the kitchen, electric plate warmers, small electric heating units for the bath rooms, and so on.

There are baseboard receptacles and floor outlet boxes wherever extensions are likely to be needed or the plugging in of some electrical devices likely to

become desirable. For instance, in the bed rooms there are wall receptacles for extensions for reading lamps, and others for curling irons and the like; the dining room and dining porch have floor outlet boxes, and in the bathrooms are receptacles for attaching electric heaters whenever these may be wanted. After going over the installation one can hardly see how it could have been improved upon, either as to equipment or character of work.

Iron Pipe Used for Electric Conduit[1].

The manufacture of rigid metallic conduit has become an industry of importance to the chemical engineer during the past decade. The competition among the manufacturers of this class of material has become very keen and has helped to develop a variety of methods of treating pipe to make it conform to the requirements of the National Board of Fire Underwriters. As the competition increased, the quality of the finished product increased and now the conduit is of a very high grade.

At the present time butt-welded mild steel pipe 10 feet long is used for conduit. This makes a cheap and excellent base since it is very rugged and can be easily worked.

The present manufacture of unlined conduit may be divided into two general classes, enameled and galvanized. The enameling affords protection to the pipe by a corrosion-resisting film of enamel while the galvanizing affords protection by galvanic action.

It is only within the past few years that the sale of galvanized or so-called "white pipe" in contrast to the black enameled or "black pipe" has reached large proportions.

The manufacture of "black pipe" appears as a simple proposition, but the large number of difficulties that appear in carrying out the process of enameling requires a great deal of technical skill to insure success.

The enamel interior provides a smooth raceway for wires. Its generally excellent appearance, its cleanliness, smooth interior and its cheapness makes the black pipe very popular among the installers.

While the general practice in the manufacture of "black pipe" is essentially the same at all plants, the practice in the "white" or galvanized pipe industry varies widely. This difference is due primarily to the three galvanizing methods used, these being hot galvanized, electro-galvanized and sherardized. Approved conduit of all these three types are on the market.

The chief trouble that has been encountered in the manufacture of hot galvanized conduit has been the wiping of the interior of the conduit to secure a thin, flexible, and adherent coating. The present hot galvanized conduit on the market has a smooth wiped interior and exterior surface while the threads are clean, yet well coated and need no recutting. The coating is somewhat heavier than is found on electro-galvanized or sherardized pipe yet it is flexible and adheres well to the iron base.

This coating contains aluminum in varying amounts, often being as high as 10 per cent. The addition of this metal improves the hot galvanizing bath without materially increasing the cost owing to its low specific gravity. The aluminum gives the finished conduit a pleasing white appearance.

The interior if this hot galvanized conduit is not enameled but a peculiar blue black wash is used. It is a thin coating and is merely used as a distinctive finish and helps the finishing qualities slightly.

The one sherardized conduit is made by the sherardizing process and has a coating of zinc-iron alloy on the interior, exterior, and threads.

The baking enamels used contain linseed oil as a base. The other consitutents are tars, asphaltums, pitches, and gums, giving it its black color. The usual thinner is benzine. The enamels are made in many grades depending upon the amount of linseed used. By using a small percentage of linseed oil and a large proportion of asphaltums dissolved in benzine a very cheap enamel baking at a low temperature may be made. By using a high percentage of linseed oil with dissolved gums and asphaltum added an excellent one baking at high temperatures may be made. The addition of small percentages of other materials is practiced to improve certain qualities.

A method of testing for a good enamel is as follows:

Remove a strip of enamel from the pipe with a sharp knife. This strip should approach rubber in its elasticity and yet should be hard enough while on the pipe not to be easily scratched by the finger nail. Even after ageing for several years in a warm atmosphere this test should still apply.

The general methods used in conduit pipe enameling are alike and differ merely in details. The pipe is hung on racks and dipped into a tank of enamel, and after withdrawing and dripping is run into an oven and baked.

The clean, dry pipes coming from the pickle room are ready for enameling. The couplings on one end found necessary to secure complete separation of the pipes in the pickling vat are again found necessary to hang them upon the enameling racks.

After the pipes have been hung upon the racks they are dipped into the enamel which is usually contained in a riveted iron tank about 11 feet deep, two feet wide and long enough to accommodate the dipping rack. The tanks often contain 1,000 gallons of enamel. With an enamel worth 65 cents per gallon the value of the contents is a considerable sum and precautions must be taken to prevent its becoming ignited, to prevent any deleterious foreign matter entering it or to prevent adding a poorer quality of enamel which necessitates testing of all new lots of enamel.

The danger of fire is increased by heating the enamel by steam coils in the bottom of the tank. The heating is necessary to maintain a constant temperature and to thin the enamel. This method is safer, cheaper and gives better results than thinning with benzine. If a volatile solvent is added the enamel continually changes in consistency with corresponding variation in the finished product. Warm enamel also coats the pipe more evenly by eliminating any air bubbles clinging to the pipe surface.

The rack of pipe is lowered into the enamel and allowed to remain until it has reached the same temperature. It is then hoisted out of the tank and the pipe allowed to drip for about a minute after which they are run over dripping pans and allowed to remain until ready for baking. The excess enamel on the dripping pans flows back into the tank.

With the various grades of enamel this preliminary air exposure accomplishes different purposes. With a high grade, high temperature baking enamel this exposure to the air does not cause any hardening of the enamel but merely allows some of the excess enamel to drain. With a medium grade, benzine-thinned enamel the benzine evaporates, leaving a jelly-like coating that hardens in the surface with medium temperatures. With a cheap enamel containing a larger percentage of benzine, the latter evaporates leaving an enamel that is but slightly tacky and which becomes hard with a slight baking.

After the preliminary air treatment the pipes are run into the baking oven.

The design of the baking oven is dependent upon the enamel used. In general they are made of firebrick with ample ventilation for all fumes and gases evolved.

If a low temperature baking is used steam coils may be placed in the bot-

[1] Part of an article in *Metallurgical and Chemical Engineering.*

tom of the oven and adequate heat furnished by these to finish the drying of the enamel.

Where higher temperatures up to 700 degrees Fahrenheit are desired two general methods are in use, the direct and indirect.

The direct method is used where natural gas is available or other gas can be obtained at low cost. The gas is burned directly in the baking oven in a kind of hearth of brick that are heated to a white heat. The object is to secure as complete combustion of the gas with as little excess of air as possible. The hot gases of combustion circulate among the pipe and bake the enamel. With small excess of air there is little danger of igniting the fumes evolved. With incomplete combustion soot would be deposited upon the tacky enamel and spoil it.

With the indirect method of heating the hot gases of combustion are led through radiators which heat the air to be used in baking the enamel.

The efficiency of the direct method is very high when compared to the indirect. With the latter there is no danger of spoiling the enamel with the products of combustion and there is no danger of an explosion should the oven door be accidentally opened during the "heat."

When a medium enamel which hardens slowly in the air is used the oven is run at a temperature of 300 degrees to 400 degrees Fahrenheit. When the oven is first warmed a small amount of enamel may drip from the bottom of the pipe due to the thinning of the jelly-like film left after the evaporation of the solvents.

With one that must be baked at a temperature of 600 degrees Fahrenheit, the operation is not as simple. When the oven warms, the enamel thins and excess will drip to the bottom of the furnace. This dripping will continue for some time, usually until the solvents have evaporated and the linseed oil has begun to harden. The excess is drained into a well from which it is periodically returned to the tanks, apparently having suffered no deterioration.

Sherardized conduit receives an exterior and interior coat of clear enamel. Previous to this practice a coat of clear enamel was put upon the interior only and the exterior was paraffined. The clear enamel was used to aid finishing while the paraffin was used to lay the objectionable loose zinc dust that remained on the pipe.

Electro-galvanized conduit is made by varying methods. Only the exterior is plated since the plating of the interior has not been put on a commercial basis. Usually the threads have little or no coating on them.

One brand of conduit is made by flashing the cleaned iron pipe in a copper bath and plating over this copper with zinc.

Another manufacturer obtains a smooth velvety adherent coating by wire brushing the pipe before coating with zinc. A second brushes the conduit after plating and obtains a bright finish which is pleasing to the eye and does not discolor easily.

All "white pipe" is enameled in the interior to help the finishing and with the cold galvanizing to provide against oxidation of the iron.

The coatings used in the interior of conduit cover a wide range. The colored wash in the hot galvanized and clear enamel in the sherardized have been mentioned. Electro-galvanizers use a black enamel except one who uses a red iron-oxide enamel paint, which is of an excellent quality, instead.

Enameled or painted "white pipe" is now sold extensively. The enameling of this pipe does not present any difficulties beyond those found with the black pipe. The applying of a paint presents difficulties of a different nature. The pigments used settle quickly and some method must be devised to keep it evenly distributed throughout the oil. The stirring may be accomplished by means of a propeller. Even with stirring, the conduit will not be evenly coated by the pigments. The more practical way of applying the paint would be by means of a spray. In this way the pigment would be more evenly distributed and not be washed away as it is when the conduit is withdrawn from the tank.

When sherardized pipe was paraffined the following method was used. A solution of paraffine of the requisite strength was made in warm benzine. This solution was contained in a horizontal tank capable of holding 5,000 feet of 0.5-inch conduit. Steam coils kept the solution hot to prevent the paraffine from freezing out. About 5,000 of 0.5-inch pipe, after enameling the interior, was dipped into this tank in one bundle. Any superfluous dust was washed off and settled to the bottom while a thin layer of paraffine remained on the pipe after the benzine had completely evaporated.

After the conduit has been galvanized and enameled it is inspected, labeled, and bundled, and it then is ready for shipment.

A union of electrical workers has been organized in Lexington, Ky., and has already established unusual strength. The organization embraces moving-picture operators as well as practical electricians.

Among the Contractors.

M. H. Kessler of Chicago is installing the electrical work in a large building belonging to the Leiter Estate in this city. Circuits for some 500 incandescent lamps are to be put in.

The Beaver Electric Construction Company of Chicago has been awarded the contract to install the circuits for about 900 incandescent lamps in the building at 3014 Lincoln Avenue, Chicago.

To the Smith Electric Company of Van Wert, O., the contract for the electrical equipment in the garage of Bonnewitz Brothers in that city has been awarded. The job will include wiring for lights and motors and the installation of electric fixtures. All circuits will be run in conduit and nothing but the highest class of construction will be employed.

E. A. Beilharz, electrical contractor of Delphos, O., has the contract for the wiring and fixture installation in the new Commercial Bank Building in Delphos. This is to be a conduit job throughout.

The Perrine-Armstrong Company of Fort Wayne, Ind., is soon to begin the installation of 300 horsepower in electric motors in its lumber mills, and J. W. Grodrian of Fort Wayne is to do the electrical work in connection with the installation of this machinery. Three-phase 440-volt motors will be put in for the operation of all machinery. The electric circuits will be installed in conduit. A high-class job which Mr. Grodrian recently completed was the installation of an indirect lighting system in the home offices of the Lincoln Life Insurance Company.

Rudolph Schuck, formerly chief electrician at the plant of the Atlantic Terra Cotta Company, Perth Amboy, N. J., and George A. Schultis have formed a partnership to engage in a general electrical sales and contracting business in Perth Amboy. Offices have been opened at 187 New Brunswick Avenue.

A ten-year lease upon valuable property on the corner of Ninth and Main Streets in Cincinnati, O., has been closed by the Rugg Electric Company, of that city, and a handsome new building will be erected for this well known electrical concern. The Rugg company now occupies quarters in the Gerke Building. E. H. Dornette is the architect for the new home of the electricians, and a contract for a building with every modern appointment has been awarded the William B. Barr Company.

Dollar Wiring Kinks.

Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Screwdriver for Close Work.

I used to have a great deal of trouble in fastening screws in some of the close quarters where electricians sometimes have to work. Finally I hit upon the plan of putting a small piece of tape over the point of the screwdriver bit and forcing this into the groove in the screw head. This prevents the screw from falling off, and makes it easy to start screws in places difficult to reach with the fingers.

Charles E. Rietz.

Hanging Short-Stem Fixtures.

Not long ago I had to hang some chain fixtures which were to be suspended from stems. The canopies and stems were of the same height. These fixtures came all wired to hang from fixture blocks. Since I did not want to take the fixtures apart, I had to find some other way of screwing up the crowfoot. I finally decided upon the following.

I screwed the crowfoot on to the block first. Then I placed a hickey having one male thread on the stem, and took out both wires through the sides of the hickey. It was then quite simple to screw fixture, hickey, etc., all into the crowfoot. This left enough room to make the splices, and left a secure job.

Joseph B. Josephson.

Wiring Fixtures.

I have noted in several issues descriptions of good schemes for wiring fixtures. In the following is described a scheme which I have found valuable in cases where the fixture tube is comparatively small and the fixture contains a right-angle turn. It is to take a piece of fine steel wire fitted with a hook on the end and pass it into one end of the tube, and then take a similar piece and fish through the other end until it engages the one previously pushed in. By hooking them together, one piece may be pulled through and this can then be attached to a piece of No. 18 copper wire, to which the fixture wires may be attached.

William A. Murray.

Drying Out the Floor Box.

Recently while inspecting some noncemented floor outlets, I found that a number of the boxes had accumulated a dangerous quantity of moisture. After wiping the boxes out, I found that there still remained dampness on the sides and in the ends of the conduit. I placed a 16-candlepower lamp in the box and ran a drop cord to the nearest socket. After turning on the current and leaving the lighted lamp in the box for half an hour I discovered that the floor box was entirely dry.

W. F. Dimelow.

A Convenient Tool for Soldering.

When one is trying to solder "pig tails" on a ceiling it is hard to keep the torch from smoking the ceiling sometimes. I got around this difficulty by using the tool shown in Fig. 1. This is a ladle made of a half-inch gas-pipe cap and a piece of No. 18 fish wire. How the tool is put together is clear enough from the figure. By filling this little ladle with hot solder and applying it to the joints to be soldered, I not only do a good, clean job but I can solder the joints much faster than would otherwise be possible.

Fig. 1.—Cup for Solder.

A. A. Vilter.

Passing an Obstruction in a Wall.

In wiring already built houses difficulties are sometimes encountered in dropping the steel-armored cable or the flexible conduit down a wall to a switch outlet. Generally the trouble arises from the fact that pieces of 2 by 4-inch timber have been nailed in crosswise from one upright to another. Usually the electrician cuts a hole in the wall so as to get to the end of the cable and the obstruction, and such holes can never be patched so that they will not show.

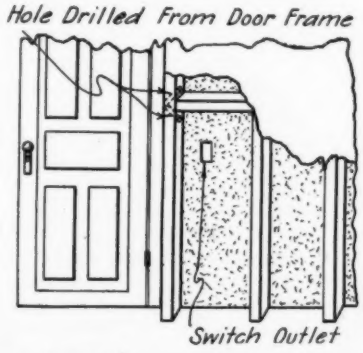


Fig. 2.—Method of Pulling Conductors Around Obstruction.

Switches, as a rule, are placed near doorways, and there is usually a stop for the door which consists of a strip about an inch and a half or two inches wide attached to the wall. What I consider the best procedure is to remove this strip, and, under it, drill two holes in the cross-piece, one upward at an angle of 45 degrees and the other downward at the same angle. The holes should then be chiseled in until the cable can be pulled through, after which the strip is replaced. Fig. 2 illustrates the job.

J. B. Wathier.

Convenient Rough Determination of Resistances of Cables.

Sometimes it is desired to determine roughly the resistance of a cable. For this purpose I have found the following rule very useful.

The number of thousand circular mils in the cross-section of the cable is numerically equal to the length in feet required to produce a resistance of 0.01 ohm. For example: in a 2,000,000-circular-mil cable, 2,000 feet have a resistance of 0.01 ohm; in a 500,000-circular-mil cable, 500 feet have a resistance of 0.01 ohm; in a 300,000-circular-mil cable, 300 feet have a resistance of 0.01 ohm; etc.

Results thus obtained are accurate to about 4 per cent, and the simple form of the rule makes it easy to remember and to apply.

Edgar P. Slack.

The Fixture Stud Had Been Forgotten.

Having had occasion recently to install some chandeliers in a new concrete building, I found one outlet without the necessary fixture stud, this stud, no doubt, having been overlooked at the time the conduit was installed.

After some study, I decided to drill two holes, each one-quarter inch in diameter, through the box and into the concrete for a depth of one inch, using a small reamer to ream out the holes already in the box and a small star drill in the concrete. I then inserted two quarter-inch lead expanders and screwed the stud firmly into place with ordinary wood screws, making as solid an installation as if the stud had been installed in the customary way.

R. W. Robinson.

Threading Conduit.

Sometimes a wireman has to cut two or three threads on a piece of conduit while he is working on a job where there is no vise nor suitable post to attach one to. The best way to proceed in such a case is to place the stock in a corner or an angle and turn the pipe into the stock, instead of the reverse. Anyone who has tried to cut a thread by holding the pipe with a wrench will appreciate this. I know by experience with men that this little kink is not commonly practised.

Ben R. Browne.

Thirty Years Ago.

Electrical News of 1883 as Presented in the "Electrical Review," the Only Electrical Weekly Published in the United States at that Time—Sixth Installment.

(From "Electrical Review," New York, April 26, 1883.)

The most recent item from Moscow in regard to the coronation preparations is that no fewer than 4,000 electric lamps cover the cupola of the great belfry tower and 120 the cross.

The new factory of the Western Electric Company at Chicago will be 50 by 250 feet in dimensions, with wing 110 by 58, four stories in height, and will represent an expenditure of $100,000.

The Bernstein Electric Light Company has recently put its light into the Boston Post Office. It has been pronounced a success by all who have examined the features of this new incandescent light.

The Pennsylvania Electric Light Company has, after examination of the different electric lighting systems, adopted that of the Fuller Electrical Company, and an installation of 100 lights has recently been shipped to the capital of the Keystone State.

In the United States Court at Chicago, on April 5, Charles F. Brush and others filed bills against the Van Depoele Electric Light Company and J. Irving Pearce, to restrain them from using the Brush patents, issued October 23, 1877, for improved metal-plated carbons.

Great things are to be expected in the future from electricity. The limit of its application is not even in sight, and the wonders that have already been accomplished through this agency give us reason to entertain the belief that this generation shall pass away with the end of electrical development not yet attained.

In obedience to the order of the mayor, the telegraph companies in the city of Chicago have been gathering their wires into cables carried on short poles, and so arranged that they can be thrown to the ground in case of fire. On the sixteenth instant the Council passed an order directing the mayor to cause these cables to be removed at once.

A meeting of the stockholders of the Mutual Union Telegraph Company was held on the eighteenth instant, at the office of the company, 135 Broadway, for the purpose of ratifying the lease of the lines of that company to the Western Union Telegraph Company. There were represented by the owners in person or by proxy, 93,340 shares of stock, and the vote in favor of ratification was unanimous.

A Montreal firm has invented and patented, it is said, a machine for cooking by electricity. It consists of a saucepan so isolated by non-conductors that the bottom forms the positive pole of the current. The negative pole is attached to a movable point which travels in circles over the bottom of the pan underneath, distributing the heat over the whole surface and with sufficient rapidity to avoid burning a hole through the pan at any one point.

At a recent meeting of the Board of Directors of Columbia College it was decided to establish a practical school of electrical engineering as an adjunct to the School of Mines. This school is to be fitted with working models of all the recent electrical inventions. A well known practical electrician was asked by the trustees to estimate the cost of the necessary plant, and he replied that $15,000 would cover the first cost, and after that the school could be kept up for $25,000 a year.

The Commissioners of the Cincinnati Exposition Society have decided to adopt a new style of register, to be worked by electricity. Instead of each of the nine registers recording separately, they are all to be connected with a dial in the office of the board. Each register is to be numbered and each is to have five dials, on the same plan as a gas meter, so that each will record entrances up to 99,999. The work will require about 2,000 feet of wire and a number of batteries. C. E. Jones and Brother are to put in the work.

M. d'Arsonval, the well known telephonist, has devised a new form of Bell receiver, which is, for its size and weight, the most powerful yet constructed. The chief modification consists in enclosing the bobbin entirely between the poles of the magnet. This is done by making one pole of the magnet the core of the bobbin, and the other pole an enclosing ring of iron. The inductive plate vibrates over the poles and upper surface of the coil as before. The complete instrument only weighs a little over five ounces and is stated to be as powerful as the heavy Gower-Bell receiver.

Ex-President Diaz, with his wife and the members of his suite, were initiated on the sixteenth instant, to a limited extent, into the mysteries of Edison's system of electric lighting. The party was conducted on its tour of observation by Thomas A. Edison and his wife, N. F. Hastings, secretary of the company, and Colonel Sherman, who represents the company in South America. The party visited the First District works, in Pearl Street, and then the machine shops in Goerck Street, and Mr. Edison's laboratory, at Seventeenth Street and Avenue B. Elaborate explanations were made by Colonel Sherman, who is an old friend of General Diaz, and were listened to with much apparent interest by the members of the party.

When some time ago we wrote that the telephone interests of this country would surpass in value the telegraph interests, we were not aware how quickly this would be the case. Despite the fact that the Western Union Telegraph Company has a share capital of $80,000,000, double the capital of the same company some time after the telephone was invented, this $80,000,000 of capital, at its market price of 84, does not equal in value the market price of the Bell Telephone capital, combined with the market value of the subcompanies working under its patents. That the commercial value of the telephone, five years after its introduction to the public service, should be greater than the value of the telegraph system of this country after 25 years of operation, no one would have dared to predict until very recently.

The unipolar dynamo-electric machine is the name given to the electric generator invented and patented by Charles E. Ball, formerly of Philadelphia, which is quite different from the Pacinotti, Gramme, Brush, Edison,

Weston and all other generators now in use. Mr. Ball says: "I have discovered that by employing only one pole of the field magnet, or what amounts to the same thing, arranging the armature to rotate within the inductive influence of only one pole of the field magnet, vastly improved results can be obtained; that is, that greater quantity and increased intensity of current are secured, while at the same time the armature will require much less power to effect its rotation than would be necessary if rotated in the field of two or more poles." It is quite possible that Mr. Ball's discoveries and inventions will effect a complete revolution in the future construction of dynamo-electric generators.

A BOAT PROPELLED BY ELECTRICITY.—Happily for those who would navigate tidal waters without being at the mercy of inconstant winds, electricity has come to their aid, and we herewith present to the readers of the ELECTRICAL REVIEW a faithful illustration of a boat which combines all the virtues of the steam launch, while at the same time possessing none of its discomforts. This boat, called the *Eureka,* is the design of that skillful and ingenious electrician, M. Trouvé, being propelled by the electrical power generated by a six-cell Trouvé battery. By means of a winch the elements of this battery may be more or less immersed in or completely withdrawn from the exciting liquid, consisting of one part of bichromate of potash, three and one-half parts of sulphuric acid, and eight of water. The current is led through the tiller ropes, made for the purpose, of twisted wires, covered with silk and cotton, and encased in an india-rubber tube, to what is called the *gouvernail moteur propulseur,* or combined rudder and propeller. The electrical motor is placed in the rudder head, while the propeller itself revolves in a slot in the rudder itself, the motion being communicated by an endless chain. So greatly is the action of the rudder intensified by this arrangement that, unlike its prototype propelled by steam, this boat can be made to turn almost on its own center. So fast will this electrical boat travel through the water that, at a recent trial, a four-oared gig or racing boat going at full speed was easily overhauled and passed by her. We look forward with agreeable anticipation to the construction of one of these craft for our own waters, in the full conviction that, when its many advantages are thoroughly comprehended, the building of a fleet of them will follow. The time is not far distant when electrical storage stations will be found on the banks of all populous water courses, and the owner of the electrical boat can obtain a new supply of electrical power without difficulty, and at a cost, too, which, instead of proving, as in the case of the steam launch, by far the largest item in his expense account, comparatively insignificant.

"Thirty Years Ago"—Trouvé's Electric Launch of 1883.

We believe that the popular theory at the present time is that electricity, like heat, is molecular motion. If we take the movement expressed by the molecules of matter, the motion of heat is sluggish when compared with electrical molecular motion. Professor Gray says that the difference between the two motions may simply be in rate, or it may be in form, or in both; most likely in the latter. An electrical conductor does not perceptibly expand unless there is a conversion into heat. This would lead to the conclusion, possibly erroneous, that the molecular movement is in the same plane and that the energy is propagated by the impact of one atom or molecule against another successively. We hope that at no distant day we shall have collected in one spot every known electrical contrivance of value, in practical running order, and the most fitting place for such a collection would be in that portion of Columbia College known as the School of Mines.

In no place, probably, has the use of the telephone become more general than in Brooklyn. The business is now under the control of the Long Island Telephone Company, which has done as much during the past six or eight months as it did during all the previous periods of its existence. "We have doubled our subscription list since last July," said General Superintendent W. D. Sargent. "We then had 800 subscribers; we now have 1,600. We have extended our lines to Jamaica, Far Rockaway, Hempstead, Babylon and Patchogue, and we expect ultimately, probably during the summer season, to reach the other end of the island. We have opened a paystation at Coney Island, and will have stations in all the leading hotels on the beach. About 5,000 messages pass over the wires daily in this city, and between Brooklyn and New York the number is some 30,000 a month. A great change has taken place since the latter part of 1881, when the company had only 101 instruments in use."

The most important experiment in underground telegraphy which has been undertaken in this city is now in process of construction by the Chicago Sectional Electric Underground Company, which has purchased the patents and adopted the plan of the Philadelphia company of the same name. This company has secured a right of way from the city limits to a central point in the business district (about four miles), and is laying a cast-iron box, four inches square, as a conduit. There is to be a manhole at every street corner, four by six feet in dimensions, with an 18-inch opening at the top. There is to be laid in this conduit a carrying wire, which is to be divided off in sections of a block and joined at the manholes. The wires of the Postal Telegraph Company are to come into Chicago through this conduit. Each tunnel will hold 50 electric light wires and from 400 to 500 telephone and telegraph wires. The test is to be conducted under the supervision of Professor Elisha Gray, the inventor of the wire and process used by the Postal Telegraph Company, and Professor Barrett, representing the city.—*Chicago Post.*

A meeting of representatives of electrical companies was held on the twentieth instant, in the Boreel Building, in response to a call from the Gramme, American, Brush, Edison, Fuller, Jab-

lochkoff, United States, and Western electrical lighting companies. The object was to be an examination into devices for underground wires for electric purposes, with a view to a union of all the companies in a single system. Eleven telegraph companies—including the fire-alarm and police telegraphs—four district messenger companies—including the burglar alarm, a telephone company, and five electric lighting and power companies, are employing wires in this city. Several of these companies possess underground rights, of which a few have taken advantage. The Edison Company has a complete system in operation, extending under 16 miles of streets. The 21 companies, having substantially the same requirements, could not lay independent systems because of the immense absorption of capital and the disturbance of the streets. Among those present were: Thos. J. Montgomery, of the Brush-Swan Electric Light Company; R. R. Hazard, of the Gramme Company; G. W. Hebard, of the United States; Clarence Cary, of the Western Union; H. W. Pope, of the Manhattan District; Major Eaton, of the Edison; A. B. Chandler, of the Fuller; Mr. Shaw, of the Law; J. P. Davis, of the Metropolitan Telephone & Telegraph; E. Holmes, W. E. Athearn, H. C. Roome; Henry Morton, of the Stevens Institute; Elliot Smith; C. A. Cheever, of the Jablochkoff; Mr. Bailey, S. J. Gorden, S. L. Parish, Mr. Frick; and W. C. Behrens, of the Gramme Company. Mr. Davis acted as chairman, and Mr. Behrens as secretary. Resolutions were adopted declaring that the time had arrived for making an exhaustive examination of all devices for underground electrical communication.

The officers of the Brush Incandescent Illuminating Company announce that Mr. Brush is now ready to manufacture storage batteries at the rate of 70 a day, the works in Cleveland, O., being finished. Mr. Brush says that he has greatly improved his batteries since the exhibition of their power which was given last autumn, and now has no hesitation in competing with gas or any system of electric lighting. He became convinced years ago that the arc light, while well suited to street illumination, would not do for dwelling houses or even for many public buildings. The light is too trying to the eyes, and casts too black shadows to be pleasant indoors. The incandescent light is as soft as that of gas and does not affect the atmosphere. For reasons of economy it was decided that any system which would permit of incandescent and arc lighting from the same machines and wires was to be aimed at, and the storage battery was settled upon as the best device for holding the electricity for each house. The great advantage of the storage battery is that no matter how irregular the charging of the battery may be, its emission of electricity is perfectly steady; no matter how a cistern may have been filled, the flow of water from its faucet will be perfectly regular.

The plan of the Brush Company is to put batteries into every cellar and connect them with the street wires which feed the street lamps. The company is making four standard sizes of battery—five lights, ten lights, twenty lights, and forty lights. They can be put in any part of the house, from cellar to garret, or in vaults under the sidewalks. Mr. Brush contends that the batteries will improve with age. It is well known that upon the appearance of the first Brush storage batteries outside of the company's office, suits will be instituted for infringement of the Edison lamp patent and of the Faure storage-battery patents. About every expert and patent lawyer of prominence in the country is ranged upon one side or the other in the coming contest, which promises to be the most important ever fought over patent rights.

(Quotations from ELECTRICAL REVIEW of May 3, 1883, will appear next week.)

Public Service Commissions

MASSACHUSETTS.

The hearing by the Massachusetts Gas and Electric Light Commissioners on the petition of the Mayor of Newburyport, Mass., for a reduction in the price of city lighting, which was set for April 21, was cancelled, the mayor having requested that the case be indefinitely postponed.

The Amherst Gas Company, a combination gas and electric distributing company, has asked the Commission's approval of an issue of $75,000 new capital stock at $100 per share, the proceeds to pay floating indebtedness incurred in enlargement of plant.

NEW JERSEY.

The Board of Public Utility Commissioners has granted the Commonwealth Water & Light Company permission to issue bonds for $20,000 for improvements and extensions to the plant of the Lakewood Water, Light & Power Company, a subsidiary company recently acquired.

NEW YORK.

The New York Railways Company has served upon the Public Service Commission for the First District a writ of certiorari, issued by Supreme Court Justice M. Warley Platzek, to review the action of the Commission in requiring the company to set aside 20 per cent of its gross earnings each month for maintenance and depreciation. This requirement was embodied in the order of the Commission issued February 27, 1912, approving the mortgages issued by the New York Railways Company in the reorganization of the old Metropolitan Street Railway Company, which it succeeded. The company claims that the Commission has no authority to make such an order, and that in so doing it illegally substitutes the judgment of the Commission for the judgment of the company's directors.

The Public Service Commission, Second District, has authorized the Montgomery Electric Light & Power Company to increase its common capital stock from $35,000 to $100,000 and to issue stock to the total par value of $49,000, the proceeds to be used for the redemption of outstanding bonds, and for the payment of liabilities incurred for improvements and additions to its plant.

The Commission has authorized the Mexico Electric Company to exercise franchises for the furnishing of electricity in Mexico and Palermo, Oswego County.

A reduction in telephone rates from subscribers' stations within the so-called exchange area of Forest Hills, in the Borough of Queens, to principal points in the Borough of Manhattan from 10 to 5 cents, has been ordered. The new rate must be put into effect on or before June 1, 1913. The order was made following the complaint of Forest Hills Taxpayers Association of Elmhurst.

The Commission has ordered the Granville Telephone Company to restore be-

fore May 15, 1913, the limits of the exchange area including Shushan to the status existing prior to October 1, 1912, and to cease making any toll charge for messages between its subscribers located in Salem, N. Y., and other points in the former exchange area in the State of New York. On October 1, 1912, the company established a new schedule of rates whereby the subscribers of its Salem exchange are required to pay increases for local service, and at the same time the company changed the Salem exchange area by excluding the Shushan, N. Y., and Rupert, Vt., exchanges and introduced a toll charge of 5 cents per message between its subscribers located in Shushan, N. Y., and those in Rupert, Vt.

The Commission has authorized Fred J. Auburn, of Cicero, Onondago County, to exercise a franchise for the furnishing of electricity in Cicero and Brewerton.

WISCONSIN.

The Wisconsin Railroad Commission held a hearing on April 22 in the City Hall, Milwaukee, Wis., in regard to the revision of the standards for gas and electric service which have been in force for the past five years.

David Harlowe, a member of the Commission, conducted the hearing and C. F. Burgess, professor in the University of Wisconsin, an expert for the Commission, represented the Commission at the hearing. The morning session was devoted to the rules governing gas service and the afternoon session to the rules relating to electric service.

The Wisconsin Electrical Association had appointed a Committee on Electric Service Rules Revision consisting of F. A. Vaughn, chairman; S. B. Way and George Allison. This committee had drawn up proposed amendments to the tentative rules and had presented these to members of the Association for approval. Replies had been received from 38 members of the Association and with few exceptions these replies favored the suggested changes of the Committee. The Committee was represented at the hearing by Mr. Vaughn, who was called upon to express the views of this committee upon each one of the suggested rules.

The members of the Meter Committee of the National Electric Light Association also attended the hearing and expressed their opinions upon the desirability of certain of the rules, considered in the light of their own experience. Among others taking part in the discussion were C. R. Phenicie, of Green Bay; L. H. Lathrop, of Menominee; P. H. Korst, of Janesville; C. A. Wixson, of Rhinelander; B. F. Lyons, of Beloit; Robert Young, of Sheboygan; O. C. Irwin, of Berlin; T. A. Pamperon, of Oconto; Otto M. Rau, of Milwaukee; and S. Morgan Bushnell, of Chicago, Ill. The manufacturers of meters were represented by J. W. Bard, of the Sangamo Electric Company; William Bradshaw, of the Westinghouse Electric & Manufacturing Company; and Chester I. Hall, of the Minerallac Electric Company.

The principal changes proposed in the rules are as follows.

Rule 16 is amplified to permit meters of capacities not exceeding 250 volts and 10 amperes to be simply inspected for correct connection in position, etc., and tested approximately with a calibrated lamp, providing they have been first tested in the laboratory of the company. Where transformers and shunts used with meters are not tested in conjunction, they must be separately tested at least once every five years.

Rule 17 referring to the frequency of tests in service is entirely changed. Tests are to be required at only two points, three-quarters and one-tenth of full load with at least two test runs of 30 seconds each which shall agree within one per cent at each load. The following schedule of the times within which tests must be made was proposed: single-phase induction-type meters, every two years; commutator-type meters of capacities not exceeding 250 volts and 50 amperes, every year; all other meters, every six months; in no case shall commutator-type meters with sapphire jewels be permitted to make more than 1,000,000 revolutions between tests. Mr. Vaughn proposed to replace this with the following schedule: single-phase induction meters up to 25 amperes, 30 months; single-phase induction-type meters above 25 amperes, 24 months; polyphase induction meters up to 150 amperes, 24 months; polyphase induction meters over 150 amperes, 12 months; direct-current commutator meters up to 220 volts and 25 amperes, 18 months; from 25 to 500 amperes, 12 months; over 500 amperes, 6 months. This is the schedule recently adopted by the Public Service Commission of the First District of New York.

Mr. Bard pointed out that the mercury meter was not specifically mentioned and hence would be included in the "all-other" class; whereas there was no reason why it should be tested any oftener than the commutator meter. Mr. Lathrop thought no distinction should be made between polyphase and single-phase meters, since they have the same characteristics, but thought 500-volt meters should be scheduled also.

W. H. Fellows, chairman of the Meter Committee of the N. E. L. A.; C. G. Durfee, a member of the same committee; and S. M. Bushnell, of the Commonwealth Edison Company, Chicago, also spoke in favor of longer periods between tests, especially where the more modern types of meters are used.

Rule 18 referring to records of meter tests is amplified so as to state more definitely what data shall be kept and the manner in which they shall be kept. Most of the remarks in regard to this rule were in favor of keeping original records of tests on file and not requiring such tests to be copied on a separate card, as such work where heretofore attempted had been found useless.

Rule 21 set four per cent as the limit of tolerance.

There was considerable discussion regarding Rules 24 and 25, the former requiring the utility company to inspect the lamps of customers every two years and render them assistance in securing lamps best adapted to the service. The previous experience of all companies which had attempted such inspections and advice to consumers was to the effect that unless this was requested by the consumer the attempts did not result satisfactorily, as most customers regarded it as an unwarranted intrusion into their private affairs. Mr. Vaughn suggested that a printed booklet covering this question should be prepared, or at least edited, by the Commission, and distributed by the utility companies as coming from the Commission.

Three new rules were added. Rule 26 requires bills to give the registration of the meter at the beginning and end of the interval and the dates of reading the meter.

Rule 27 requires the electric company serving more than 250 consumers to have one or more graphic recording voltmeters, at least one of which must be kept in continuous service. All voltage records are to be kept open for public inspection.

Rule 28 refers to the use of maximum-demand meters and requires these to be tested for accuracy at the same intervals and in as careful a manner as watt-hour meters. If graphic recording instruments are used they shall be tested, and if necessary readjusted, at least once each month. Considerable opposition was expressed against this rule, owing to the inherent difference between maximum-demand indicators and watt-hour meters, and it is probable that this rule will be modified or dropped.

Copper Exports.

Exports of copper for the week ended April 17 were 7,464 tons; since April 1, 18,270 tons; last year, 13,266 tons.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions

No. 138.—Electric Fly and Rat Traps.—Can a voltage less than 110 be used successfully in electric fly traps? What is the best voltage for electrocuting rats and mice?—M. A., Johnstown, Pa.

No. 139.—Overhead Cables for Light and Power.—Telephone companies in the large cities are now generally using overhead cables in the alleys with only the drop wires to the individual subscribers as open-wire lines. Has this method ever been used for electric light and power distributing circuits? Is it feasible for this purpose? About what would be the relative cost of such distribution compared with the present plan of having all alley wires of the open type?—E. L. T., Birmingham, Ala.

No. 140.—Electrical Equipment of Gasoline Automobiles.—Which type of electrical equipment is better for gasoline automobiles, to have the electric starting, lighting and ignition combined in one system, or to have a separate outfit for each purpose? What are the advantages of each plan?—C. B. W., St. Joseph, Mich.

No. 141.—Use of Control Resistors as Heaters on Electric Cars.—The grids resistors used in connection with the control equipment on motor cars of elevated railways seem to dissipate a great deal of heat. Has any attempt ever been made to utilize this heat in place of, or as an auxiliary to, the electric heaters usually employed for warming the cars in winter?—J. T. A., Chicago, Ill.

Answers.

No. 130.—Emergency Loan of Motors.—In the case of a shop driven by a single motor from a central-station supply line, is it the common practice of the power company to loan a spare motor temporarily, if the motor in the shop has broken down or needs repairs that would otherwise require shutting down the shop for three or four days? If this is done, what is the basis of charging for this service?—W. M. K., Kankakee, Ill.

I have noted your question 130, and the answer in the issue of April 12, by F. H. P., of Indianapolis, and I must disagree with him in regard to what he terms the usual practice of central stations, as I believe his answer is misleading. If the party asking the question is trying to settle on a policy to be followed by his own company, the answer given might cause him to take the wrong steps to build up his business. So far as my experience goes, it shows that the up-to-date and progressive central station tries to assist not only its own customers but also any prospects, however remote. Such central stations generally keep a stock of both new and second-hand motors and will either sell outright, sell on a monthly-payment basis, or rent. You understand, of course, that I am speaking of a progressive and going central station, and not of those small and poorly run stations that make no effort to get power business. A particular central station, with which I have the pleasure of being connected, supplies both direct current and alternating current. A stock of both types of motors, some new and some second-hand, is kept, the sizes ranging from one-eighth horsepower to as high as 40 or 50 horsepower. These motors are sold as near cost as possible on any of the following terms: net cash; cash in 30 days; one payment when order is placed and 5 or 11 monthly payments. The motors are also rented, the charges being based on interest on the investment, depreciation and cost of delivery and recovery of motor. In one particular case a customer wanted temporary service for about a year. He needed a 5-horsepower, a 15-horsepower and a 40-horsepower motor. No. 40 horsepower motors were in stock at the time, and the central station therefore bought a new motor. The rental charges made were as follows:

40 H. P. motor.....	$12.00 per month.
15 H. P. motor.....	5.00 per month.
5 H. P. motor.....	4.00 per month.

In another case the engine of a private plant was destroyed by fire. The central station stepped in, rented motors to the concern, and had the whole plant running in a few days. The customer was so satisfied with the motors and so grateful for the help that he did not rebuild his steam plant. There are numerous cases that could be cited, but they can all be summed up in a few words, the progressive central station helps its customers and prospects, and lack of motors is not allowed to stand in the way of showing a prospect the advantages of electric drive, or of helping a customer in trouble.—Y., Baltimore, Md.

No. 131.—Setting Cedar Poles in Concrete.—Is it desirable to set cedar poles in concrete instead of directly in ground without protection? I am told that the concrete setting is so rigid that when violent storms occur the pole is liable to be broken off sharply right above the concrete around the base. Is this a common occurrence?—L. R. E., Davenport, Iowa.

The writer set a line of 40 and 50-foot cedar poles from Moline to Rock Island, Ill., in the summer of 1899. The butts were given a good coat of coal tar and set in concrete 8 inches thick around the pole and 6 feet deep. In my opinion poles set in this manner are not any more liable to break off than when set in dirt and I am sure they will last much longer. I have not seen the line recently, but have heard nothing to indicate that the poles are not still sturdy and strong.—O. P. S., Denison, Tex.

No. 134.—Changing Meters to Lower Frequency.—I would like to find out from some of your readers who have had experience how to change meters from 133 cycles, 110 volts to 60 cycles, 110 volts. I have a job of this kind in prospect. Can motors be changed in the same manner?—W. T. G., Augusta, Ill.

Having just completed a similar job on 150 meters satisfactorily, I submit the following, which are the types and makes that I have changed. Same were changed from 110 volts, 133 cycles to 110 volts, 60 cycles.—(Westinghouse Type B.) At either side of the meter will be found a screw and washer which clamps a copper strip with an oblong hole in it and same has two marks on each end. These screws are just back of the drag magnets and at the ends of same. Loosen these screws and push the bar in until the outer line coincides with the mark on the casting to change to 60 cycles, and tighten the screws.—(Westinghouse Type C.) Remove the element from the case by taking out the three long screws and on the back of the element will be found a small screw with a fiber washer. Remove the washer and put the screw back tightly in its place and it is changed to 60 cycles.—(Fort Wayne, Type K-K3.) Beneath the frame holding the permanent magnet is a coil of wire. Projecting from this about one-eighth inch are the ends of two wires (about No. 20) these are already tinned and should be soldered together to change to 60 cycles.—(Fort Wayne. Type W.) In the right-hand side of the case are two coils one above the other with iron cores. To change to 60 cycles, cut the two large (No. 20) copper wires which come out from the left side of the upper coil and solder the two together at the left side of the lower coil.—(Scheeffer, Diamond. Type E.) In some there are two wires that come out below the meter core. These are rubber-covered and have a small spiral of German silver wire soldered to their ends. To change to 60 cycles, the spiral is cut so as to leave

only one-quarter inch of wire and soldered. If the meter has three terminals instead of two, and two coils of German silver wire, the free end is connected to the extra post for 60 cycles.—(Sangamo, Types E, F and H.) These meters require no changing.—(Stanley and Gutman.) The only change we found necessary for these meters was to readjust the speed to adapt them for use on 60 cycles and they are running nicely.—I should advise W. T. G. to send to the manufacturers for bulletins relating to the types he has in mind. Motors cannot be changed to 60 cycles in the same manner and as far as I know manufacturers make no provision for this change.—H. M., Blandinsville, Ill.

To change motors from 133 cycles frequency to 60 cycles, it is necessary to reduce the number of poles to half their former number. An eight-pole motor must be rewound to four poles; a 12-pole to six poles and so on. The number of ampere-turns and size of wire remain the same across line. It is seen from the above rule that some machines are changeable while others are not. The same is true of some meters.—V. S., Portland, Ore.

No. 135.—Armature Connections of Motor.—On a 9.5-horsepower, two-circuit, 220-volt Westinghouse motor, what difference will it make to connect the armature leads one over half, or one under half, the commutator having 105 bars?—C. J. Oakland, Cal.

The effect of the two different connections mentioned would be the same electrically. In changing the lead connections from one bar under half the circumference to one bar over half, would reverse the polarity of the machine terminals.—M. C. G., Streator, Ill.

If all other conditions are qual to previous winding, the change of commutator pitch of 52 to 53 or 53 to 52 will effect a change of rotation of the armature, but practically speaking it makes no difference whatsoever.—V. S., Portland, Ore.

No. 136.—Heating Device and Pull Sockets.—Is it considered safe to connect heating devices taking about 550 watts to pull-switch lighting sockets? I have found in a number of cases where flatirons were used on what seemed to be well constructed pull sockets that after several months' use the contacts would suddenly become fused and the switch could not be pulled on or off.—G. H. T., Adrian, Mich.

It certainly is not safe to connect heating devices taking 550 watts to pull-chain sockets. I have in mind a place where a flatiron that used about this amount of current was connected to a pull-chain socket, and one day the person that was using it was called to the front of the house, and pulled the chain to shut the current off, and left the cord and plug in the socket. The current arced across the switching contacts and set the insulation of the lamp cord on fire; it crept up the cord and was on the way to start a good fire when it was discovered and extinguished. The practice of the manufacturers of heating devices, of advertising that their products are adapted for use on any ordinary socket is doing a great deal of harm, and should be stopped. A key socket (which has a much better break than a pull) is only approved for 250 watts, and to put a device using over 500 watts on a socket, and thereby overloading it over 100 per cent is not only unsafe but is absolutely dangerous.—E. W. D., Boston, Mass.

This is generally the case when a 500-watt load is placed on a socket intended for 250 watts. In any case, however, the iron or other device should not be turned off and on from a socket.—H. M., Blandinsville, Ill.

Missouri Electric, Gas, Street Railway and Water Works Association.

Annual Convention at Kansas City, April 17-19, 1913.

At many state conventions there is in attendance only a small portion of the entire membership, probably due to a failure through lack of interest to comprehend the advantages of concerted action. Realizing the desirability of thoroughly organizing the public-utility companies of Missouri, that subject was featured in the opening address by J. E. Harsh, of Sedalia, first vice-president, who, in the absence of the president, P. A. Bertrand, of Jefferson City, presided over the seventh annual convention of the Missouri Electric, Gas, Street Railway and Water Works Association, held at the Coates House, Kansas City, Mo., April 17 to 19. More particularly, Mr. Harsh recommended that the committee on arrangements for the conventions be appointed a year in advance of the meeting so they would have opportunity to adequately prepare for the entertainment of the convention; that the program committee be appointed at the time of the preceding meeting so the best possible program could be worked out with the more definite assurance that papers would be prepared and distributed to the members before the time of the meeting, and thus result in freer and more profitable discussion at convention time; that an aggressive and persistent membership committee be appointed to interest and if possible obtain the membership of every utility company in Missouri; that a standing committee be appointed to keep in touch with all state and municipal matters affecting public utilities, advising the members of developments; and that all members should subscribe to the best periodicals covering their respective lines and should make these accessible to their employees.

The committee appointed to consider the chairman's address recommended in its report the appointment at the current meeting of program, entertainment, membership and advisory committees, the first three committees to look after the work indicated by their title and the advisory committee to look after legislative matters. These committees were later appointed.

"Solving the Small Power-User Problem," was the subject of a paper presented on Thursday afternoon by F. Johnson, district manager at Kansas City of the Wagner Electric Manufacturing Company, the main feature of the paper being the advancement of the use of single-phase motors.

In response to a question by R. J. Irvine, of Moberly, Mr. Johnson stated that he did not think there is or should be any limit on the use of the single-phase motor, citing an instance of a customer using single-phase motors as high as 50 horsepower, and larger motors would be used if they were obtainable.

Small Transformer Substations.

The next paper presented was prepared by L. E. Hildebrand, of the University of Missouri, on the subject of "Small Transformer Substations." In the absence of Mr. Hildebrand, R. K. McMaster, of Kansas City, read the paper. It was pointed out that the supply of electrical energy at medium voltage to small communities and farms is very desirable to any central station on account of the better load-factor and diversity-factor thereby obtained. The investment and operating costs per kilowatt are very high, however, in the case of small indoor substations. Fortunately, outdoor substations have

been made thoroughly practical and their installation and maintenance cost is relatively low. In supplying such load continuity of service is not so important as providing service.

P. W. Markham, Brookfield, opened the discussion by stating that his company had a number of lines to small towns from which it also supplied farmers along the line, tapping off a 6,600-volt line parallel with which was a 2,300-volt line. The farmers were charged a minimum of two dollars. The farmers generally read their own meters and telephone the readings to the company. A man is sent out once in a while to look over the line and check up the meter readings. The farmers furnish their own transformers and, except for short distances, furnish their own main lines. The rate is on a sliding scale from 15 cents down to 10 cents. The protective apparatus or the lightning arrester is placed right with the transformer at the present time, but if real high-tension were employed a different kind of arrester would have to be used.

Two papers on "Hydro Electric Development on the White River," by T. O. Kennedy, of the White River Construction Company, Branson, Mo., and the "Conversion of the Raw Material to the Finished Product," by F. B. Uhrig, of the Western Electric Company, both papers being illustrated by stereopticon slides, occupied the entire session on Friday morning and were very interesting in their description of the details concerning the propositions considered.

A short session was held Friday afternoon preceding the automobile trip around the city. An invitation was extended to the association by the Mississippi River Power Company to visit the Keokuk dam and hydroelectric project at the time of the next annual convention, which was unanimously accepted. It is expected this will attract a large attendance at the next convention.

Lynton T. Block, of the Utilities Indemnity Exchange, St. Louis, in reviewing the work of the Exchange for the past year pointed out that it had saved the members more than 50 per cent on their insurance premiums. He announced that it expected to write fire insurance during the coming year in addition to the liability insurance which it has written so successfully for several years.

Electricity in Progressive Agriculture.

One of the most interesting subjects presented at the convention was "Electricity as a Factor in Progressive Agriculture," by E. P. Edwards, of the General Electric Company. The application of electricity to farm machinery is a source of great possibility and the following excerpt from Mr. Edwards' paper will therefore be of interest:

What does your product cost? You must answer this question before you can determine upon a selling price. But competition and the law of supply and demand may prevent you from securing the price and profit that your costs warrant.

What is the remedy? You must reduce costs or increase your output for the same costs.

Four prime factors enter into the total cost of all manufactured products, be those products, flour, cotton cloth or locomotives. They are: (1) The cost of labor. (2) The cost of raw material. (3) Fixed charges, or the cost of insurance, interest on the plant investment, depreciation and repair. (4) Selling expense.

Of these factors, the cost of labor is the most important, because it usually represents the largest part of the total cost and is most susceptible to fluctuations, up or down. Eliminate or reduce the cost of the labor required to feed, clean, house and milk your cow, the cost of separating the cream from the milk, churning the cream and making butter and you eliminate or reduce the larger part of the cost of producing that butter.

Or you can effect reductions in cost, if you can increase your production without a corresponding increase in the time and labor items. In other words, the efficient use of energy and the use of efficient energy is the secret of low costs.

The average cost of manual labor on the farm, throughout the United States, is 11 cents per hour, exclusive of board. The average cost of horse labor is 8 cents per hour. Mechanical power is less costly than either. Obviously, the substitution of mechanical power for manual and animal labor, whenever possible, will reduce the cost of production.

There is something over 30,000,000 people in this country engaged in gainful pursuits; one-third of this number follow agriculture; one-fourth manufacturing. There are approximately 30,000,000 horses and mules in the United States, and 90 per cent of these are used in agriculture.

The value of our manufactured products slightly exceeds that of our agricultural products. This means that the individual farmer, using practically all our horses and mules, produced only $800 worth of farm products, while the same man, if engaged in manufacturing, would produce $1,100 without additional assistance.

These figures show that the farmer has a practical monopoly on the more costly forms of power, while his city brother uses the cheaper mechanical energy almost exclusively and the bulk of this energy, as finally applied, is electrical.

The farmer has profited enormously through the use of such improved apparatus as he has used: witness the traction engine with which he can plow from 10 to 100 acres a day at a greatly reduced cost per acre. Imagine, if you can, what it would mean to put in our present crops by the old methods.

One man using two horses and a 12-inch bottom can plow about 2.5 acres per day as a maximum, the average is nearer 1.5 acres. It would take him 256 days to plow one square mile, and he would have to walk 5,280 miles to do it. Through the use of a 120-horsepower traction engine he could do the same work in a week at a much lower cost.

The wheat drill, corn planter, grain binder, threshing machine, cotton gin, and other labor and time-saving devices, enable the farmer to increase his production without increasing the time and labor required.

We know that the farmer finds use for a greater variety of implements and mechanical contrivances than almost any other industry. Is he operating these implements and contrivances most economically? Today, he does not know; today he is at the mercy of every manufacturer engaged in the building of power apparatus. He must buy power apparatus on faith and with experience only as a teacher. The reputable manufacturer endeavors to the best of his ability, to meet the farmer's needs with reliable apparatus, but is hampered through his ignorance of those needs and the farmer's disinclination to experiment.

On the other hand, the manufacturing plant makes a careful analysis of its power problem, utilizes the most efficient kind of power and constantly strives to supplant manual labor with cheaper power and labor-saving devices. The success that has been attained is due largely to electricity.

Today more than 90 per cent of our urban population is electrically served. The cost to the consumer of such service, based on an average of 10 cents per kilowatt-hour (the equivalent of 7.5 cents per horsepower-hour), amounts to one-quarter of a cent per lamp-hour for lighting, based on the energy consumption of a 20-candlepower Mazda lamp. The cost of electric power when used for other purposes than illumination averages about 5 cents per horsepower-hour. Both of these costs are decreasing and will continue to decrease as the demand grows.

A one-horsepower motor costs approximately $65, with an operating cost of 3 cents an hour. A good horse costs $150 to $250, with an operating cost averaging 8 cents per hour. A one-eighth-horsepower motor, equivalent to one man power, costs $40, with an operating cost of less than one cent an hour.

Contrast these initial costs and operating expenses. The necessity for substituting electrical power for animal and manual labor wherever possible becomes immediately apparent, especially in view of the fact that the cost of manual labor and horses is going up and the supply does not meet the demand.

Today we find the use of electricity confined almost exclusively to our cities, towns and villages. It is easier and more profitable to distribute electricity in the centers of population and naturally the easiest thing has been done first, but done so well and thoroughly that it now becomes necessary for the central station to reach out into the rural districts, if it is to so expand. Such expansion will result in great mutual benefit to the farmer and the central station, but the movement will be retarded until the farmer comes to a realization of what electric service will mean to him and until he is prepared to use electrical energy in

sufficient quantity to pay for its distribution.

The farmer cannot afford to carry a single crate of eggs to a distant market and sell those eggs by the dozen from house to house.

The central station man cannot afford to run his distributing line for miles into the country for the sake of a few scattering customers who want light only.

The farmer wonders why he cannot be served from the transmission line that crosses his place. Let us get at the reason.

The country is rapidly being covered with a network of transmission lines, carrying electric current from a central generating point to various distributing points and passing through rich agricultural lands where much of the energy could be used to great advantage. It is necessary to transmit this energy at very high pressure, for economical reasons, but it must be reduced or stepped down for ultimate use.

Transmission lines are operated at pressures ranging from 2,300 to over 100,000 volts; they cost from $300 to $7,000 a mile to build, and the apparatus for tapping these lines and reducing the voltage costs from $250 to $12,000 for each station.

Assume that a 6,600-volt transmission line, one mile long, costs $500 and that the apparatus required for tapping this line costs $250. The fixed charges on this investment of $750 must be added to the cost of generation and paid by the consumer.

Again assuming that one mile of 110,000-volt transmission line costs $7,000 and the apparatus for tapping it costs $12,000, the ultimate consumer must pay the fixed charges of $19,000 and use sufficient energy to equalize the unit cost of the current to him.

Obviously, an individual cannot do this unless his energy requirements are far above the normal, or unless he combines with other individuals and each uses all the energy he economically can.

Electricity is the only form of energy that can be purchased in bulk and distributed in small quantities over a large area; it fits in admirably, therefore, with other co-operative schemes, and the farmer is vitallv interested in co-operation.

If central-station energy is not available, the isolated electric plant can be used for many purposes at a saving in cost, but such a plant can no more compete with the central-station plant than the individual making his own shoes can compete with a large shoe manufacturer.

The small isolated lighting plant as a pioneer is doing work of tremendous value, but in order to secure maximum economic results lighting should be combined with power application. Instead of purchasing a set of one-half or one kilowatt capacity for use in lighting alone, the farmer should purchase a set large enough to operate his dairy machinery, water pumps, churns, washing machines, hay hoists, ensilage cutters, and other power-operated machines which are coming into widespread use on the farm. The increased investment involved would be more than offset by the increased saving in operating cost.

At the beginning of the present crusade there were some arguments in favor of the low-voltage plant, consisting, as it did, of a cheap gasoline engine, a belt driving a dynamo that stored the energy generated in a battery of a few cells. The first cost was small. The regulation of the engine was bad, but immaterial, as practically all of the load was carried on the storage battery, which furnished a steady source of illumination. Also, the low-voltage tungsten lamp, as at first developed, was much more hardy than the higher-voltage lamp and less liable to break. Also, it was easier to sell the unsophisticated farmer such an outfit because of its very cheapness.

Education and development will check this tendency if it is wrong. Instead of the low-voltage set we will in all probability see generators of standard voltage and good regulation, capable of supplying current direct to the high-voltage lamp and power machinery, with a small-capacity battery as an auxiliary to furnish emergency lighting. The adoption of the higher voltage makes it possible for the manufacturer to furnish standard product in the shape of motors, lamps, cooking and heating utensils. The advocate of the low-voltage equipment points to the advisability of using small motors, fans, cooking and heating appliances, with his outfit, but where is the consumer to get them?

The higher and standard voltage permits and makes possible a wider range of distribution which is not feasible with the lower voltage.

Also, when the central station reaches out its lines and is in a position to supply current to the farmer, the latter can abandon his isolated plant and switch over to the central-station service with a maximum expenditure, which will be more than offset by the saving in cost of operation.

The isolated plant is now a necessity to the majority of farmers, because they are not within the zone of central-station distribution, and it should be designed along proper and logical lines with due considerations given to past practice and experience.

There is also a tendency on the part of the farmer to purchase a portable engine which he moves from point to point on his farm as occasion demands. When he noted the saving affected in time, economy and labor, a second engine is installed at that point where the first one had been used the greater number of times. This practice continues until a number of such engines have been accumulated.

Does it not seem logical that his condition would be very much better by the installation of a single generating unit having a capacity equivalent to the power required by his largest piece of machinery, and from this central source distribute energy through motors suitable size? The initial investment would in all probability be less for the electrical equipment, and the saving in operating costs, trouble, and inconvenience would be material.

The discussion on this paper was spirited and developed the statement by Mr. Edwards that a composite curve had been made showing that the demands in a well supplied farming community make a very pretty load. As to method of introducing electricity on the farms it was stated that the most successful had been an installation on one farm where the farmers could actually see what saving of labor and cost of operation was affected; that the farmers were very imitative. From the company's standpoint it is necessary to have just as skillful and well informed men to talk to the farmers as the central stations have today to talk to manufacturers. Farmers are rather reluctant about adopting electricity and the salesmen must be able to show a saving in dollars and cents before they will be able at all to interest the farmers in experimenting with something which they at present believe is expensive and impracticable.

S. W. Henderson, Excelsior Springs, cited an instance of a dairyman installing a 15-horsepower motor with which he cuts feed, milks 40 cows, washes clothes, lights his house and barn, saws wood and drives everything around the dairy to which power can be applied. That motor was put in on a five-year contract whereby the dairyman was to pay $120 a year as a minimum, the current being furnished at seven cents. For the first four months his bills averaged $13 and his saving in labor was about $75 a month.

Mr. Edwards suggested that another big field for dairymen was refrigeration, which Mr. Henderson had not mentioned. This serves as an illustration of the possibility of developing a nice load in rural districts, especially near towns where there is truck gardening, dairying, etc.

Election of Officers.

The following officers were elected for the ensuing year:

President, J. E. Harsh, of Sedalia.

First vice-president, C. L. Clary, Sikeston.

Second vice-president, A. C. Einstein, St. Louis.

Third vice-president, George E. Haylor, Jr., Joplin.

Secretary-treasurer, F. D. Beardslee, St. Louis.

Entertainment.

Generous entertainment was provided by the associate membership with the assistance of the Kansas City members, including a theater party, automobile ride over the splendid boulevards of Kansas City, about 70 miles of them, and a trip to Excelsior Springs on the new interurban line on Saturday afternoon after the convention. About 100 were in attendance at the convention. It is planned next year to hold the convention on a chartered boat on the Mississippi River en route to the Keokuk dam and hydroelectric plant.

American Institute of Electrical Engineers.

Mining Meeting, Pittsburgh, Pa., April 18 and 19.

The 282nd meeting of the American Institute of Electrical Engineers was held at Pittsburgh, Pa., on April 18 and 19, in the Fort Pitt Hotel. This meeting was devoted to the subject of "Electricity in Mines," and was held under the auspices of the Pittsburgh Section and the Committee on the Use of Electricity in Mines.

The first session was called to order on Friday morning in the English room of the hotel by E. L. Farrar, chairman of the Pittsburgh Section. He introduced Ralph D. Mershon, the president of the Institute, who made a brief address, referring to the formation of the new Committee and the possibilities open for its activities. He also referred to the expense involved in committee work and the general question of Institute finances.

George R. Wood, chairman of the Committee on the Use of Electricity in Mines, was then called to the chair, and presided at all of the sessions.

The first two papers to be presented were by H. C. Eddy on "Purchased Power in Coal Mines" and by C. W. Beers on "Central Station Power for Coal Mines." These papers will be found elsewhere in this issue.

K. A. Pauly opened the discussion by pointing out the agreement as to the desirability of central-station power between engineers representing both interests who had had experience in the matter. The public-service corporation can deliver power more cheaply than the mine owner can generate it because all its energies are devoted to that one problem and efficiency is carefully watched. Moreover the total load-factor of the central station is better because of a greater diversity of load. The reliability is greater also. He referred specifically to the steam and fuel consumptions, mentioned by Mr. Beers. While fuel is cheap at the mine, it is only one item in the cost of power, and moreover the low-priced fuel is not necessarily the most economical. The inferior grades are high in ash content, require more labor, and create higher cost for boiler maintenance. The figures given for steam consumption of obsolete equipment refute the claims of steam advocates. Much of the inefficiency is due to wear with age. On the other hand, the efficiency of electric motors varies but little with length of service. He cited a case of a mine hoist which used 75 pounds of steam per shaft horsepower-hour. When idle, the fuel consumed was about half that required for hoisting.

E. D. Dreyfus said that the Pittsburgh district had been the pioneer in applying central-station power to coal mines on a large scale. One must go cautiously into the subject of power costs, as conditions vary greatly at different mines. There are more variable factors and intangibles than are generally appreciated. The character of mine equipment should be considered as carefully as power costs, and he urged the employment of the best talent in planning and executing an installation.

These papers were also discussed by George H. Morse, T. E. Tynes, Warren Partridge and W. E. Dickinson.

H. H. Clark then presented a paper entitled "Safeguarding the Use of Electricity in Mines."

Safeguarding the Use of Electricity.

The sources of danger attending the use of electricity in mines are shocks, fires and explosions. Shocks are the electrical accidents that happen most frequently underground, the conditions there being especially favorable to the occurrence of such mishaps. Fires may be caused by leaks to ground, short-circuits and blowing fuses. Injuries to electrical equipment, due to falls of roof, often add to the fire hazard. Explosions may be result of the ignition of explosives, mine gas or coal dust. Mr. Clark discussed the underground conditions that are unfavorable to the proper installation and maintenance of electrical equipment and suggested some methods of making safer the use of electrical equipment in mines. The closing paragraphs of the paper discussed electrical equipment as a means of promoting safety and mentioned the telephone, the portable electric lamp, electric shot-firing devices and storage-battery locomotives as equipment that may be regarded as lessening the risks surrounding the underground worker.

This paper was discussed by Graham Bright, W. E. Dickinson, Wilfred Sykes, L. R. Palmer and George R. Wood.

Mr. Bright pointed out that a mine is not a good place for a storage-battery locomotive, as storage batteries usually require considerable care and this would probably not be accorded to them. They certainly would not stand the treatment which is usually given to a locomotive. This type of locomotive may be suited to industrial plants where a better class of operators can be obtained, but it is not suited to a mine.

Professor Dickinson referred to the possibility of shot-firing by stray currents or induced currents, and mentioned a case where an accident had been caused by this means. He thought lead wires should be twisted to avoid the possibility of induction.

Mr. Sykes stated that the steel mills were now giving great attention to safety, as they had found it paid, and the number of deaths per ton in this kind of work is now less in the United States than in Europe, although a few years ago it was several times as great. Mr. Palmer called attention to the Safety Congress held last year at Milwaukee and stated that copies of its report were now available.

Mr. Wood stated that accidents with electricity are less than were formerly experienced with mules, whereas the output per man has been doubled.

In closing the discussion, Mr. Clark stated that he thought the storage battery for mine locomotives was a step in the right direction and would eventually be practical. There is one type of storage battery now on the market which stands a great deal of abuse.

Before the above discussion a demonstration of the method of resuscitation, known as the Schafer prone-pressure method, was given by C. A. Lauffer, M. D. In answer to questions by J. S. Jenks, he stated that resuscitation could sometimes be assisted by the use of aromatic spirits of ammonia, which should be used to saturate a handkerchief held three inches from the nose of the patient. Where this is not available, household ammonia may be used with caution. Hypodermics were sometimes advantageous, but should only be administered by a physician. He favored atropine and strychnine for this purpose. He stated that results in restoring respiration were usually obtained within 20 minutes, but he had known cases where it was necessary to continue the efforts for nearly three hours in order to save the patient.

The pulmotor was exhibited by the Draeger Oxygen Apparatus Company, of Pittsburgh.

Alternating-Current Motors for Mine Fans.

At the afternoon session the first paper to be presented was by F. B. Crosby and was entitled "Alternating-Current Motors for the Economic Operation of Mine Fans."

The author emphasized the steadily increasing tendency toward more highly specialized equipment for definite classes of service with resulting improvement in efficiency and operating

characteristics. Mine-fan applications are considered under two general heads: (*a*) those requiring constant-speed and (*b*) those requiring adjustable-speed drive. The necessity of selecting the proper type of motor for each case is pointed out and the statement made that in view of recently perfected methods of speed regulation, the polyphase induction motor is equally applicable for both constant and adjustable-speed service. Several methods of obtaining speed control, which have been used in the past, are briefly discussed and their limitations indicated. The latest development involving speed regulation is by dynamic control as opposed to rheostatic control, and the striking advantages of the former in the way of strictly adjustable speeds, each constant under varying load; high operating efficiency throughout the entire range of speed reduction; and the important possibilities of high power-factor correction, are described. An example of net saving effected by dynamic as compared with rheostatic control is cited. For smaller fan installations, a new type of polyphase motor is described with which starting, stopping, and forward and reverse speed control are obtained by shifting the brushes. The polyphase motor in some one of its several forms is eminently suitable for any and all fan installations, save possibly in cases where an existing direct-current system is already installed.

The discussion was opened by C. W. Beers, who directed attention to the fan. In the anthracite region, fans are mostly below 50 horsepower and a constant speed is usually desired. It is an exceptional case where variable speed is required. As the mine is developed, the volume of air necessary increases, but the pressure decreases. It is poor economy to increase the volume by increasing the pressure. The correct method is to split the current of air, or vary the air courses so as to keep the fan speed constant.

Wilfred Sykes spoke of the regulation of motor speed by the use of commutators. As mine fans usually receive little attention, he did not consider a three-phase commutator motor desirable for this purpose. Two speeds are usually sufficient to meet the requirements and these can be realized by using a two-speed machine or by changing the belting ratio. Practices which have been successful in Europe do not always work well in the United States on account of the lack of expert attention.

H. Meyer-Delius stated that in Europe a new mine makes use of either throttling or reduced speed of motor. The latter is more economical. He knew of 30 of this type in Germany, running up to 1,200 horsepower. About 30 per cent regulation is usually required. He did not consider the attendants in German mines intelligent. He stated that they nevertheless used commutating motors without trouble. A common price for energy from a central station is 0.75 cent per kilowatt-hour.

W. O. Oschmann stated that in Pennsylvania the mining law requires that every fan be provided with a recording meter showing the pressure. The fan may not be stopped until after the foreman is notified, and if it is stopped unintentionally all miners must leave the mine.

B. M. Fast stated that in his territory he had not seen any fan motor larger than 50 horsepower. Less air is usually required at night and he thought power could be saved by slowing down the fans. He recommended the use of either a two-speed motor or a wound rotor with external resistance. The former is preferable, but the cost is higher.

H. L. Beach favored changing the pulley in order to alter the speed and when the power required exceeded the capacity of the original motor, a duplicate could be added to help drive the same fan.

Others joining in the discussion were George R. Wood, H. C. Eddy, Graham Bright and G. E. Miller.

In closing the discussion Mr. Crosby stated that the manufacturer receives most calls for an adjustable-speed motor. For motors smaller than 100 horsepower he considered the method of shifting brushes to regulate speed the best. He considered the method of control for an alternating-current motor to regulate speed no more difficult than that with a direct-current shunt motor. All that is necessary is to shift a rheostat.

Central-Station Power.

J. S. Jenks then presented a paper entitled "Central-Station Power for Mines." This was illustrated with lantern slides.

The paper was devoted chiefly to a historical sketch of the West Penn system in regard to its electrical service in connection with coal mines. The first mine installation was connected to the system in 1896 and previous to that time it had been found very difficult to convince the mine operators of the advisability of central-station service, as they claimed that it was not as reliable as an isolated plant. The central-station service was also antagonized by the mine inspectors, who frequently prohibited central-station service for certain uses, especially for fans, contending that mine ventilation was of such importance that no mining company should be dependent upon another corporation for its power for fan operation. These objections were only overcome after several years of successful operation in a large number of mines. The author mentioned a number of mine installations which have been supplied by central-station power and described various difficulties that have arisen in regard to such installations and the methods of overcoming them. The growth of this business is shown by the fact that since the original installation of 120 horsepower in one mine, the company now supplies power for 76 coal mines aggregating nearly 15,000 horsepower, and has contracts with 10 companies for over 5,000 horsepower to be installed as soon as possible. The maximum load-factor is 40 per cent and the minimum 6 per cent.

Graham Bright in discussing this paper stated that there had been originally a prejudice against central-station power, but its fine record for continuity of service has given operators confidence in it and made it comparatively easy for the central station to secure contracts.

Load Characteristics.

The last paper at this session was by H. M. Warren and A. S. Biesecker and was entitled "Characteristics of Substation Loads at the Anthracite Collieries of the Lackawanna Railroad Company." This paper was presented by Mr. Warren.

This paper dealt with a series of tests made on substations which supply power for driving direct-current machinery at the anthracite mines of the Lackawanna Railroad Company. A description is given of the substations and motor equipments on apparatus in the mines. The instruments used and methods employed in conducting the tests are outlined. The results of the tests are given in the form of a set of curves showing load-factors, diversity-factors, peaks, and a characteristic load curve. The effect of the load-factors and peaks on the size and type of apparatus in the substation is discussed and suggestions are made for substations to meet special conditions. The following table gives the load-factors for various periods for the largest substation, having a capacity of 1,720 kilowatts and the average for all substations. The load-factors are computed upon the basis of connected load.

	Largest Per cent	Average Per cent
1 Hour	29	32
8 Hours	26	25.5
10 Hours	24.6	24
24 Hours	14	12.5
Annual	9.6	8.6
(Night) 14 hours	6.6	6.2

The discussion of this paper was mainly taken up with the question of the meaning of the word "load-factor," how it should be computed, what dura-

tion of maximum demand should be considered and what bearing this element should have upon the rate of payment for power. Those participating in the discussion were Graham Bright, W. A. Thomas, J. P. Clayton, George H. Morse, C. W. PenDell, George R. Wood, P. M. Lincoln, S. G. Vigo, C. I. Weaver and T. E. Tynes.

It was pointed out that the load-factor should be based on maximum demand rather than on connected load, and that the maximum demand might be determined for various periods varying from 30 seconds up to one hour. Mr. PenDell pointed out that in his experience a load-factor of 40 per cent based on a 5-minute peak would be reduced to 34 per cent if based on a 30-minute peak. The Public Service Company of Northern Illinois bases its contracts on a 5-minute peak in the case of coal mines and quarries, upon a 30-minute peak in the case of general power applications and upon a 60-minute peak in the case of electric railways. A 15-minute peak is also used in some cases in the Central States. He preferred the use of a longer peak and a correspondingly high scale of power rates rather than a low scale based upon the value of a short-time peak. Mr. Weaver stated that in Indiana and Michigan the 15-minute peak was used and it was customary for the power solicitor to examine the conditions of the customer and tell him about what the contract rate would amount to expressed per ton of output. Mr. Clayton referred to the figures for the cost of power given in the paper by Mr. Beers and showed that if the load-factor were reduced from 50 per cent to 20 per cent the cost per kilowatt-hour would go up from 0.8 to 1.8 cents and for 15-per-cent load-factor would reach 2.4 cents. Mr. Morse pointed out that the Wright demand indicator did not give the maximum power where there was an inductive load, but since it is the current capacity which fixes the limit to the generating and transforming apparatus rather than the power represented in the load, it is preferable to measure the maximum current rather than the maximum power.

A Dutch dinner was held in the Fort Pitt Hotel at 6:30 p. m., at which a few brief remarks were made by President Mershon. The remainder of the evening was devoted to a series of moving pictures entitled "From Mine to Molder." These were shown through the courtesy of J. R. Darragh, of Rogers, Brown & Company, and were accompanied by an explanatory lecture by J. B. Yergason. They represented the various phases in handling ore and metal, beginning at the mine, including the ore boat, the blast furnace, pig casting, the Bessemer converter, rolling of ingots and wound up with the finishing of steel rails.

Electric Power in Mines.

At the final session on Saturday morning the first paper presented was by J. W. Hopwood entitled "Electricity as Applied to Mining." Mr. Hopwood pointed out that the location and environment of a mine were not conducive to securing the best type of labor. He examined typical conditions in the mine power house and showed that inefficiency and lack of proper attention were customary. The costs for electric power are usually high and unknown. Transmission of electric power from the power house to the point of use is usually accompanied by the very worst conditions. Poor regulation and low voltage are common and greatly reduce the efficiency of both men and apparatus and lead to numerous burnouts of armatures, etc. The feeder cables soon get in bad condition and breakdowns frequently require the closing of the mine. Inefficiency is manifest throughout. He stated that it is common to find locomotives, pumps, cutting machines, etc., designed for 250 volts, actually operating on 75 volts. Roasting insulation is common and the repair shop is usually kept very busy. It is not only the electrical equipment that suffers from low voltage; pumps are subjected to severe strains, since they come almost to a standstill when the voltage drops down and start up at full speed under a heavy head when the other loads are taken off the line. Breakages are consequently frequent. Locomotives designed for 250 volts but operating at 150 proceed at low speed and low efficiency and require more of the men's time. Much of the machinery is evidently designed by men not familiar with the conditions to be met. This is especially true of the mine locomotive. It is also customary to find a number of different types of locomotives, machines, pumps, etc., in one mine. There has been no standardization of machinery and this requires a very large stock of extra parts in order to be prepared for repairs. He did not consider central-station power a panacea for all the ills mentioned, but thought it would correct some of the evils which are now general. He thought the substation should not be located at the mouth of the mine, but should be built ahead as the works are extended, and this would result in keeping up more uniformity of voltage. He favored the use of induction motors in order to avoid commutator trouble. The element of the cost of power was one of the least important, since much of the power now consumed is not utilized for useful purposes. He also referred to the difficulties confronting the mine electrician during his daily rounds, the poor facilities usually provided for accomplishing repairs, the scarcity of literature pertaining to mine electricity and the lack of some medium for bringing mining electricians together so that they could benefit by an exchange of ideas.

Graham Bright in opening the discussion stated that the experience of Mr. Hopwood was common in soft-coal mines. The smaller ones cannot pay a first-class consulting engineer. The central stations who supply power are ready to give this service. He stated that in the modern locomotive many of the defects pointed out by Mr. Hopwood had been eliminated. He favored a commutating-pole motor for the reduction of commutator trouble.

George W. Morse spoke in favor of legislation requiring lower voltages in order to reduce the hazard to life. He considered any voltage as high as 220 dangerous. He favored a three-wire system, metal-covered cable, smaller locomotives and six-phase rotary converters for changing to low-voltage direct current.

N. W. Storer spoke in favor of the standardization of equipment and stated that in the early days the manufacturer had to design especially cheap apparatus for use in mines.

C. I. Weaver also favored low voltage, but thought worse troubles would be experienced if a special voltage were adopted in mines, requiring special apparatus. In Indiana the transmission lines usually run above ground to a point over the center of the load and then through a bore-hole to an underground substation, from which power is distributed at 250 volts direct. He favored a motor-generator set rather than a rotary converter.

A. S. Biesecker, whose experience was in the anthracite region, stated that the question of voltage drop was largely one of the local conditions of distribution, such as bonding of rails. He has made use of discarded steel cables, which are run alongside the rails, and cross-bonded them to the rails. He favored the use of a compound-wound motor. The three-wire system had been tried in two mines that he knew of but did not work well, as a maximum load on one side was often coincident with a low load on the other, leading to an unequal division of voltage. These mines are to be changed over to the two-wire system. Iron conduit cannot be used in mines, as it soon becomes corroded. He had used six-phase rotaries, but did not favor them, and considered the proper place for a substation to be outside of the mine.

George R. Wood stated that today the mines are not asking for cheap apparatus. In fact, the standard types are often not good enough and the trouble is to get the manufacturer to make apparatus which is suitable for the purpose. He did not favor underground substations and had found boreholes unsatisfactory in Pennsylvania. He was opposed to the three-wire system on account of the variable load conditions, and favored the use of higher voltage underground.

P. M. Lincoln stated that the advantages of the six-phase rotary were not sufficient to warrant its manufacture in sizes below 500 kilowatts.

The last paper to be presented was by Wilfred Sykes and Graham Bright and was entitled "Mining Load for Central Stations."

Mining Load for Central Stations.

The paper discusses the desirability of mining loads for central stations from the viewpoints of both the mine operators and central-station operators. The power supplied to a mine from a central station is used, in general, for haulage, hoisting, ventilating, coal cutting, pumping, tipples, machine shop, blacksmith shop, and general lighting. The power required for each of these services was briefly analyzed and the types of motors for different services indicated. Rates for power were then discussed and the various methods of rate making, such as flat rates, maximum-demand system, flat rate with fixed charges, etc., analyzed. The effect of power-factor on rates and the methods of measurement of load were also considered. The paper concluded with some general suggestions in regard to power contracts.

In opening the discussion P. M. Lincoln stated that an ideal power rate should be based upon load-factor, power-factor, quantity of energy, time of peak, and should be made dependent upon the readings of cheap standardized instruments. It should moreover be easily explainable to the customer. As some of these requirements are inconsistent with others it is necessary to compromise in actual practice.

S. G. Vigo stated that a mine load was largely off the peak and could consequently be given a special rate. He also referred to the flexibility of central-station drive.

Theodore Swann spoke of the conditions in a central station of 40,000 kilowatts in West Virginia, which supplies only coal mines. A uniform contract is made with all customers. For installations under 300 kilowatts the rate is based upon a five-minute integrated peak and the circuit-breaker is set for 100-per-cent overload. For the larger installations a longer peak is used and the permissible overload reduced. The maximum load-factor, based on connected load, had been found to be 49.7 per cent, but based upon the actual demand it did not exceed 15.8 per cent. The diversity-factor for 22 plants was found to be 1.52. Based upon an installation cost of $80 per kilowatt and allowing 15 per cent for interest, depreciation and taxes, the investment charge would be $12 per kilowatt per year. On account of this diversity-factor the central station receives $18 per kilowatt per year, and is, consequently, free to spend more than $80 per kilowatt upon the installation. It is expected eventually to secure a diversity-factor of 1.75. All power is delivered in the form of alternating current upon loop circuits strung on steel towers. There are no power-factor restrictions. Charges are based upon $12 per year per kilowatt of maximum demand and 1.3 cents per kilowatt-hour, with a discount for quantity ranging down to 0.6 cents where more than 1,000,000 kilowatt-hours per month are consumed. Most of the mines in this territory are draft or slope mines and there are few vertical shafts. The conditions are, consequently, more favorable than where there is a large hoisting load. He did not favor underground substations.

H. C. Eddy also spoke in favor of uniform contracts to all customers.

S. B. Storer also favored this policy and spoke of the difficulty in agreeing upon the proper duration of peak to determine maximum demand. Most customers aim to secure a peak measurement which will not penalize them under their own particular conditions. On account of the diversity-factor involved, he thought that the demand charge per kilowatt should be larger for the large customers than for the small ones.

The last feature on the program was the Question Box. This was intended to afford a means for communicating topics for discussion for those who did not care to participate in person. Seven questions were presented and read by the chairman. The first referred to the method of operating a whistle where the steam plant had been displaced by electric power. Mr. PenDell replied to this by stating that the Gamewell electric whistle could be heard for two miles. It is also possible to use compressed air, but this is more expensive.

Mr. PenDell also replied to the next two questions involving heat for wash rooms and the removal of ice on shaker screens. He favored a small boiler for these purposes, which would naturally only be operated during the severe winter months. In reply to another question it was stated that power purchased from a central station was usually metered at the customer's voltage.

In the case of a 2,200-volt line 1.25 miles long a rotary converter is used. It is found that both the alternating and direct voltage come up when the load is thrown off. The remedy for this condition, which is probably due to a leading power-factor, is to install reactance or else put additional resistance in the field. If there is no commutator trouble the latter would probably give the best results. It would also be possible to use voltage taps.

Mr. Farrar then took the chair and adjourned the meeting at 1:15 p. m.

The High-Frequency Resistances of Inductances.

While the high-frequency resistance of non-inductive resistances can be easily determined by substitution methods, the determination of high-frequency resistance of inductances offers great difficulties. The decrement and half-deflection methods, in addition to being difficult to apply when very accurate results are desired, have also the disadvantages of including in the observed resistance all the sources of energy loss in the circuit. In an article to appear in the *Bulletin* of the Bureau of Standards, L. W. Austin gives a method which, while laborious, seems capable of giving much more exact results than the others mentioned.

The principle of the method is the following. Two equal inductance coils are placed in identical oil calorimeters; one coil is heated by high-frequency current and the other by direct current. When the calorimeters are both brought to the same temperature in equilibrium with their surroundings, the heat imparted to each per second must be the same. This heat is proportional to $I^2 R$ and the ratios of the resistances of the two coils at the given frequency and for constant current are inversely proportional to the squares of the currents. To compensate for the slight inequalities in the coils and calorimeters, the direct and high-frequency currents are interchanged and the mean values of the ratios of the current-squares taken. The high-frequency current is produced by a rotary spark gap in an oscillatory circuit coupled loosely to the circuit containing the inductance coil to be measured. The two circuits are brought to resonance at the frequency desired, and the high-frequency current in the inductance is regulated by varying the coupling. The current is read on a non-shunted hot-wire ammeter which has been accurately calibrated for high frequencies. The direct current for the other coil

is supplied by a storage battery and the final regulation for equilibrium is made in this circuit.

Equality of temperature between the two calorimeters is determined by a differential constantine-copper thermo-element. The calorimeters are heated to 20 or 30 degrees above the temperature of the room. The uncertainty of the individual high-frequency current readings is approximately one part in fifty. The mean of thirty or more readings is taken as a basis for each calculation. The calorimeters, provided with motor-driven stirrers, are of glass 15 centimeters high and 10.8 centimeters in diameter. The coils of 0.40-millimeter double-silk-covered copper wire are wound on glass.

After the determination of the resistance of the six pairs of standard coils a roller inductance of the Fessenden type was calibrated by comparison with the standard coils. The method used was as follows. A buzzer-driven wave-meter is used to excite an oscillatory circuit containing a sensitive thermoelement and variable air condenser. By means of switches either one of the standard coils or the variable inductance can be inserted in this circuit, the deflections in each case being observed on the galvanometer of the thermoelement. Sufficient fine-wire resistance is then placed in series with the inductance giving the larger deflection and adjusted until its deflection is reduced to that of the other inductance. The resistance of the standard coil for the given frequency being known, the corresponding resistance of the variable inductance at this point is at once determined. For any given wave-length, it will be found that the high-frequency resistance increases more rapidly than in proportion to the number of turns of the coil. This result is not in accordance with any of the various formulas which have been given for high-frequency resistances.

BOOK REVIEW.

"A List of Defunct Municipal Lighting Plants," Compiled by Arthur Hastings Grant. Eighth edition, revised. New York: The Municipal Ownership Publishing Company. Paper, 55 pages (6x9 inches). Supplied by the Electrical Review Publishing Company for 50 cents.

This new edition of the list of defunct municipal lighting plants has been revised and brought up to date and gives detailed accounts of 190 such plants in the United States and Canada that have been sold, leased or abandoned. In some cases the cities still operate their distributing plants. Where possible, reports have been obtained from the city authorities and in other cases from local editors, verbatim quotations from whose statements are in many cases given.

LETTER TO THE EDITOR.

Thirty Years Ago.

To the Editor:

Your articles of thirty years ago recall old times. I remember when the Bankers & Merchants Company was trying to get wires into the down-town district. I was a lineman at that time and assisted in stringing two No. 6 iron wires between Chicago and Cleveland. The Fostal-Telegraph Cable Company at that time had a single wire between Chicago and New York.

Wooden Insulator Used 30 Years Ago.

Telephone toll lines at that time were very few, and of short distance. There were no long lines.

I also assisted in building a single-wire telephone line between Defiance and Toledo, O., along the old canal. I have often wished I could go back over the same routes and see how many hundreds of wires are now there. I can remember taking wooden insulators off of telegraph lines and replacing them with the single-petticoat glass type. I have one of these old wooden insulators now in my tool box. (See illustration.) I do not believe there are many of them in existence.

O. P. Sammons.

Denison, Tex., April 7, 1913.

Kansas University Men Find Good Berths in Electrical Business.

Although nearly two months remain before graduation, every senior in the electrical engineering department of the University of Kansas has obtained a position with a prominent electrical firm. The following record of college men who thus early are assured of a propitious start in their profession is interesting.

Earl L. Wright, Pleasanton, Edison Belt, Fredonia, and Paul A. Meyer, Centralia, will go to the factory of the General Electric Company at Schenectady, N. Y. The Denver Gas & Electric Light Company has employed Thomas P. Hennesey, Fulton, and H. C. Hoadley, Fort Scott. The Westinghouse Electric & Manufacturing Company will take Elmer E. Hartman, Kansas City, Kan.; Wayne D. Thompson, Wichita, Henry H. Campion, Leavenworth, William F. Price, Topeka, and Donald K. Crawford, Topeka, will work in the Santa Fe signal department.

The Crocker-Wheeler Company, Ampere, N. J.; Western Electric Company, Chicago, and the Missouri-Kansas Telephone Company are also seeking Kansas University graduates.

Complaint of Rates in Helena.

A special committee appointed by the City Council of Helena, Mont., to make an investigation into the cost of electric lighting and the rate for power in the city reported that the rate for light and power is too high in the city and also reported that, in its judgment, the rates throughout Montana, where electricity is generated by the use of water power, are too high, and recommended a meeting in Helena on April 28 by representatives of the various Montana towns interested. The result of this meeting will probably be an application to the state public-service commission for relief.

Meter Committee Holds Meeting.

The Meter Committee of the National Electric Light Association held a meeting on April 21 and 22 at Milwaukee, Wis. The committee consists of W. H. Fellows, chairman; Percy H. Bartlett, secretary; F. A. Vaughn, Charles G. Durfee and W. L. Wadsworth.

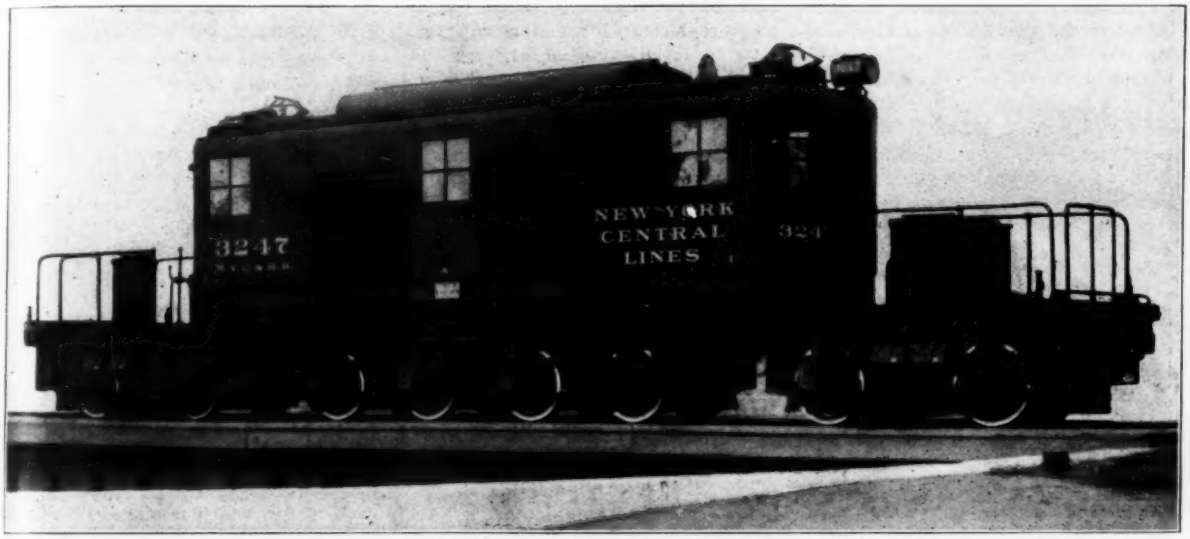
The committee is paying particular attention this year to the questions of the effect of frequency upon meters, their accuracy on fluctuating loads, standard connections for instrument transformers and corrections to the *Meterman's Handbook*.

New Electrical and Mechanical Appliances

NEW YORK CENTRAL LOCOMOTIVES.

Most Powerful Electric Locomotives in the World.

Ten new passenger electric locomotives of the most powerful type ever built are to be placed in commission by the New York Central & Hudson River Railroad Company on the terminal lines in and near New York City. A very exhaustive series of tests and trial runs of an experimental locomotive of this new type was recently made on the Harlem division. This locomotive was immediately put in service on the electrified section of the New York terminal and a contract was awarded the General Electric Company for nine additional locomotives of the same design, which are now under construction.



New Type of Electric Locomotive for New York Central Terminal.

The electric locomotives in service in the terminal previous to the introduction of the new engine weigh approximately 115 tons. While the new locomotives are considerably lighter, weighing 100 tons, they are much more powerful, are provided with ample forced-air ventilation and designed with a view to continuous high-speed service. All the 100-ton weight is carried on motor-driven axles, while the former locomotives have but 70 tons actual weight on the driving wheels.

The new electric engines will exert sufficient tractive effort to haul continuously a train weighing 1,000 tons at 60 miles per hour. In regular service they have a capacity for developing 1,400 horsepower continuously and can develop as high as 5,000 horsepower for short periods. Compared with existing types of electric locomotives, this machine has greater capacity and higher efficiency than any other high-speed electric locomotive ever constructed. Withal, its total weight, weight on the drivers and dead weight is less than that of its nearest competitor.

Briefly the history of the development of the New York Central's latest type of 600-volt, direct-current, high-speed, passenger locomotive recounts a notable achievement in designing skill. The original New York Central electric locomotive had guiding wheels in the form of a pony truck with 28,000 pounds on the axles. There were four driving axles, each carrying the armature of a direct-current, bipolar, gearless motor. To improve the riding qualities of this pioneer express electric locomotive, a guiding bogie truck having two axles was substituted for the pony truck. A further development in a subsequent type was to increase the distance between the guiding trucks and the rigid wheel-base. The riding qualities were improved but at a loss in the mechanical efficiency of the locomotives; for about 40 tons of surplus weight had been added and were being carried by the bogie trucks for the sole purpose of guiding the locomotive. The addition of motors to the bogie trucks and the elimination of this ineffective weight was the next step, so that every pound of the locomotive weight would be instrumental in producing adhesion and tractive effort. A still greater separation of the fixed wheel-base and the guiding trucks lengthened the machine so as to necessitate constructing the running gear in two halves with a spring-connected articulated joint between the frames. Thus has been evolved what is known as the "new high-speed marvel."

At the present time the New York Central & Hudson River Railroad Company is operating 47 electric locomotives in the New York terminal service. Of these, 35 were built in 1906 and 12 in 1908. They are all of the 115-ton, 484-type and are each equipped with four GE-84 bipolar, gearless motors. The new electric locomotive adopted by the company is likewise a bipolar, gearless design, but it is equipped with eight GE-89 moters and designated as type 4444. Each motor is approximately three-fourths the ca-

pacity of the GE-84 motor used on the previous engines, making the aggregate capacity of the motors on the locomotive approximately 50 per cent greater than before and affording approximately 25 per cent higher speed.

In general, the locomotive may be described as having an articulated frame with bogie guiding trucks at each end. The cab containing the motorman's compartments and that for the operating mechanism is swung between the two parts of the frame on the center pins. Each section is equipped with two-axle trucks having a driving motor mounted on each axle. These cannot be distinguished as main driving or leading trucks, since all the axles are driving axles, but they are termed for clearness rigid trucks and swivel trucks respectively.

The rigid truck is built up of heavy steel castings, the side frames being of a truss pattern with heavy top and bottom members and pedestal tie bars. The end frames and center cross frames are steel castings securely bolted to the side frames and supporting the magnet poles. The whole weight of the truck is carried on semi-elliptic and coil springs resting on the journal boxes and equalized together.

The main frame or backbone of the locomotive is a box girder built of 10-inch channels with one-quarter-inch top and bottom plates. It is approximately 10 inches deep by 36 inches in width and 22 feet in length. The frame is bolted to the top member of the rigid truck, and extends forward over the center plate of the leading truck and backward to the heavy hinge which connects the two halves of the frame. The main frame carries in its top plate the center pin which supports the weight of the operating cab. All these center pins are hollow and serve as air passages, the main box-girder frame acting as a distributing reservoir for the air delivered from the blower in the upper cab through the upper center pins and conducting it to the eight motors below.

The construction of the swivel or leading truck is similar to that of the rigid truck, except that it carries a center pin and is connected to the main frame through this center pin instead of being bolted rigidly to it.

This type of design affords a long flexible wheel-base with eight axles, but restricts the length of any rigid portion to not more than 6 feet 6 inches. All the axles are equipped with motors, but the magnetic circuit for each truck or pair of motors is self-contained and relates only to the two axles in that truck.

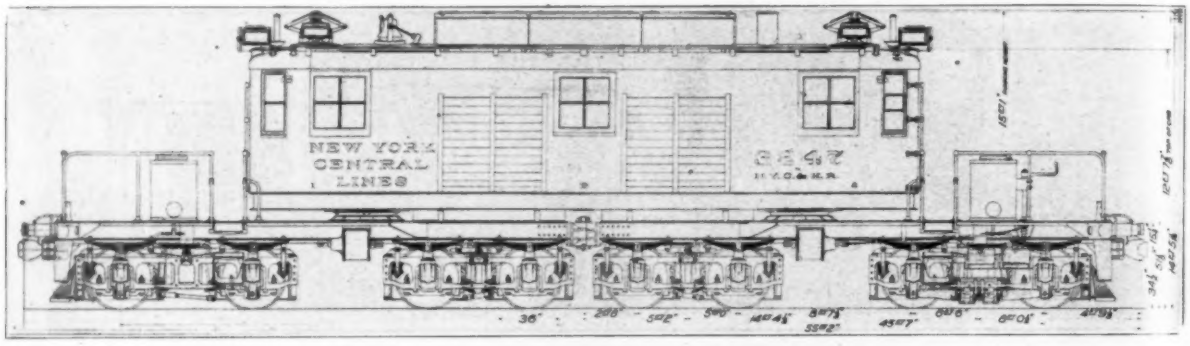
The cab has all its weight distributed between the two halves of the locomotive frame. It is of the box type 35 feet in length and 10 feet wide. The interior is divided into three sections. A motorman's compartment is located at either end and contains the motorman's seat, controller, air-brake valves, bell and whistle-rope handles, and such parts of the control apparatus as have to be within reach of the operating engineer. In the central section of the cab are the air compressors, blowers, contactors and rheostats, grouped so that they are conveniently accessible for inspection and repair, and separated from the direct reach or attention of the operating engineer. The advantage of this arrangement is that it removes from the sight of the engineer running apparatus which might serve to distract his attention from the actual work of handling the locomotive and which can be inspected and attended to by his assistant. This general type of construction leaves a fairly long platform on either end of the locomotive. Access to the cab is obtained through doors opening onto the platform.

The principal data and important dimensions applying to the locomotive are the following:

Length inside of knuckles	55 feet 2 inches
Length over cab	33 feet
Height over cab	12 feet 8 inches
Height with trolley down	14 feet 6 inches
Height with trolley running	15 feet 1 inch
Width overall	10 feet
Total wheel-base	45 feet 7 inches
Rigid wheel-base	5 feet and 6 feet 6 inches
Total weight	200,000 pounds
Weight per axle	25,000 pounds
Dead weight per axle	6,395 pounds

Taking up the specific features of the electrical equipment, the eight GE-89 bipolar, gearless motors each have the armature mounted directly on the axle. The field poles are carried on the truck frame, which forms the magnetic circuit. There are four independent magnetic circuits in the locomotive corresponding to the four trucks. The magnetic flux path on each truck passes in series through the fields and armature of one motor, through the center transom and the fields and armature of the second motor to the end frame, and then returns to the starting point through the two side frames and a reinforcing magnet bar lying parallel with the frames.

The motor is practically inclosed, and the field coils are waterproofed and armored. Each field coil is wound in a brass shell, the windings being in two decks of flat ribbon copper laid side by side. The outside turn is covered with insulation and an armor of sheet steel is clamped over it, filling the space between the sides of the shell in such a way as to protect the windings from water or mechanical injury. End shields are provided for each motor, which render it dust-tight and as nearly water-tight as is possible in any motor designed with necessary outlets for forced ventilation.



Side Elevation and Principal Dimensions of the Locomotive.

Each motor at its one-hour rating has a capacity of 325 amperes on 600 volts, or a continuous rating of 260 amperes on 600 volts under forced ventilation. For the complete equipment of eight motors, this corresponds to a capacity of 13,500 pounds tractive effort at 54 miles per hour for the one-hour rating, and 10,000 pounds tractive effort at 60 miles per hour continuously.

The motors are electrically connected permanently in parallel in pairs, and the pairs can be connected in three combinations: series, series-parallel and parallel. They are insulated for 1,200 volts, so that, if at any future time it should be desired to operate the locomotive on 1,200 volts, the pairs of motors could be changed from parallel

to series connections and the same speeds and control combinations obtained as on 600 volts.

The control equipment on the locomotive is the well known Sprague-General Electric type M and is designed to operate the eight motors connected in the three combinations referred to. The external regulating resistance, divided into four parts, is directly connected, each part to a pair of motors permanently grouped in parallel. The pairs of motors with their respective resistances are connected all in series on the first point of the controller. The resistance is varied through eight points on the controller and finally short-circuited on the ninth or running point. The pairs are then operated similarly in series-parallel with all resistance cut out on the seventeenth point. Finally all the pairs are connected in parallel with the twenty-fourth step a running point. This provides a control with nine steps series, eight steps series-parallel and seven steps parallel.

The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The smooth transition between points both rheostatic and transitional, permits motor operation close to the slipping point of the wheels. The locomotive weight on the drivers is so proportioned that the motors operate safely up to the slipping point, which serves as a limit to prevent overloading the motors. The transition between all four pairs of motors in series to series-parallel is accomplished by short-circuiting two of the pairs of motors during the instant of transfer. The transition between series-parallel and parellel is effected by means of the standard bridge method.

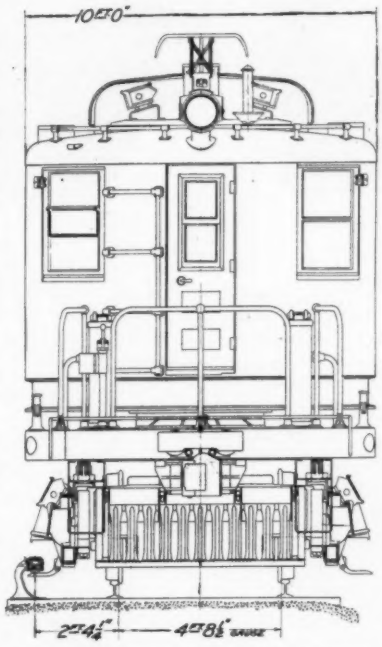
The motor cutout switches are connected so that any pair of motors may be cut out of circuit. The locomotive will operate when a pair of motors is cut out with two groupings of the motors, the first with two pairs of motors in series and the second with three pairs of motors in parallel.

The protection of the locomotive against short-circuits is very complete. All main fuses are of the copper-ribbon type; the boxes have hinged covers to facilitate fuse renewals. The box is provided with a very effective magnetic blowout, which is energized by the current passing through the fuse. The main fuse boxes are located as near as possible to the overhead trolley and to the third-rail shoes in order to protect the wiring circuits near the source of supply. Each pair of motors is locally protected by a fuse box. The main switch is provided with a blowout so that heavy currents can be opened without damage.

An ammeter is located at each motorman's position and records the current in the circuit of one pair of motors. The ammeter and air gauges are illuminated by a gauge light connected in the headlight circuit, so that one switch turns on simultaneously the headlight and the gauge light at the same end of the locomotive.

The main motor rheostats are formed of cast-iron grids mounted in a frame and insulated in mica. The rheostat boxes are assembled in the monitor deck of the locomotive.

Current is collected by eight under-running third-rail shoes, or by two



End Elevation of New Direct-Current Locomotive.

overhead trolleys when on gaps in the third rail. The overhead trolleys are of the pantograph type and are pneumatically operated. They can be put into service from either motorman's position by a foot-operated valve. The trolley is designed for intermittent use and is therefore arranged to be held in a raised position only while the valve is held open by the operator's foot.

The headlights are of the incandescent type with parabolic reflectors 16 inches in diameter. The interior illumination of the cab is provided by ten incandescent lamps arranged in two circuits, two lamps being located in each motorman's cab and the balance in the central compartment. In each lamp circuit is a portable lamp with extension cord 25 feet long. One lamp switch is located in each motorman's compartment, so that from either end of the locomotive the lamp can be controlled in that compartment, as well as half of the lamps in the central compartment.

Electric heaters are placed in the two operating compartments. The heaters are a standard electric car type, fitted with especially heavy covers to protect them from the mechanical injuries to which they are exposed in locomotive service.

The blower set provided for ventilating the driving motors is located in the central compartment. The blower has a capacity of 24,000 cubic feet of air per minute and is driven by a series-wound motor of the railway type.

The air compressor is a two-stage motor-driven compressor with a piston displacement of 100 cubic feet of air per minute when pumping against a tank pressure of 135 pounds per square inch. The air is taken from the interior of the central compartment through a screen, which prevents the entrance of particles of dust. The compressed air in passing from the low-pressure to the high-pressure cylinder is conducted through radiating pipes under the platform of the main cab. This reduces the temperature of the air and allows condensation of moisture before entering the high-pressure cylinder. From the latter it is delivered into a series of air reservoirs. There are four of these, each 16 by 90 inches. They are located under the floor of the cab and connected in series, which affords a further opportunity for radiation and condensation.

Leach type L double pneumatic sanders are provided. The sander valves are located within convenient reach of the motorman's seat, and valves and sandboxes are arranged for sanding the track in front of the leading wheels when running in either direction. The bells are fitted with Sampson automatic bell-ringers. All wiring is drawn through conduits and is carefully protected from mechanical injury.

Sterling Lamps for Large Building.

The new Heard National Bank Building of Jacksonville, Fla., is the tallest office building in the state. This building is equipped throughout with Sterling Mazda lamps. With the exception of the banking room, the lighting units consist of Mazda lamps provided with Holophane reflectors. In the smaller rooms a single 100-watt unit gives ample illumination, while the larger rooms are provided with two 60-watt units. The John I. Bronson Company, which made the installation, endeavored to make the Heard National Bank one of the best lighted office buildings in the country.

Weston Miniature Direct-Current Instruments.

The Weston Electrical Instrument Company, of Newark, N. J., has recently developed and placed upon the market a complete line of miniature direct-current instruments of the Weston permanent-magnet movable-coil type, for the measurement of current and voltage. They are made in both portable and switchboard forms. The line comprises voltmeters, special battery-testing voltmeters, ammeters, volt-ammeters, milli-voltmeters, and milli-ampere meters, in various combinations of single, double and triple ranges. The instruments are neatly finished in dull black, with nickel-plated trimmings.

Fig. 1.—Miniature Volt-Ammeter.

Fig. 3.—Battery-Testing Voltmeter.

Notwithstanding the low price at which these instruments are sold, the same great care is exercised in their manufacture as th t which is characteristic of the other well known types of Weston instruments. They

Fig. 2.—Miniature Switchboard Ammeter.

are small and very compact, the portable form having outside dimensions of 4.4 by 4.6 inches. They weigh less than one pound each, and may easily be carried in the pocket. They have a knife-edged pointer, which enables close readings to be made. The scale has a length of 2.75 inches.

The working life of an instrument depends on the proper design of the movable system, which must be very light and at the same time rigid, and the spring torque must be high in comparison to the weight and moment of inertia. The movable system in the Weston miniature instruments weighs less than 0.2 gram (less than the weight of two ordinary pins), and its parts are so well distributed that the time required for the pointer to come to rest after the application of, or change in, the current or voltage is about one-fifth second, which for all practical purposes is instantaneous. The movement of the pointer is damped, or made "dead-beat," by means of the aluminum frame on which the wire forming the movable coil is wound, in a manner similar to that in the larger types of Weston instruments.

This line of instruments has been subjected to the most severe conditions in use. They are being successfully employed on the dashboards of thousands of automobiles, where the vibration and jar are far in excess of that which would be encountered in ordinary testing.

Both portable and switchboard forms are shielded against external magnetic fields, and are practically unaffected by changes in temperature.

Fig. 1 shows a triple-range portable volt-ammeter (model 280), which is just one-half actual size. By means of this instrument any current from 30 amperes to 0.05 ampere and any voltage from 150 volts to 0.02 volt can be measured. The uses of which this type of instruments may be put are manifold. They are well suited to high school and college use, where, on account of their low price, there may be secured a sufficient number to provide each student working in the laboratory with an instrument. Amateur electricians in wireless and other lines of work will find that the use of an instrument by which accurate quantitative results may be obtained will open up new and larger fields for experiment, and explain many failures and difficulties which would otherwise be inexplicable. Railway signal engineers and all those who must carry instruments from place to place, either for general testing or inspection work, will appreciate the compact form and light weight of these instruments. Furthermore, the combination volt-ammeter with multiple range reduces the number of instruments required to be carried. These instruments are especially useful in telegraph and telephone testing and, in general, for all work where small direct currents and comparatively low potentials are used.

Fig. 2 shows one-half actual size of the model 267 switchboard form of meter. These instruments have the same general characteristics as the portable form just described. They are provided with a pear-shaped pointer-tip to enable readings to be made at a distance. They are all single-range, but are made in ranges increasing by small steps from 50 milli-amperes to 30 amperes in the case of am-

Fig. 4.—Switchboard Volt-Ammeter.

meters, and from 50 milli-volts to 150 volts in voltmeters. This form of instrument is useful for all purposes where size and weight are important factors, and also where the cost of installation must be kept low, such as indicating instruments on automobiles, battery-charging sets, isolated house-lighting plants, apparatus for physicians' use in electrotherapeutics, dental work, etc.

Fig. 4 illustrates model 268 switchboard volt-ammeter which is designed

especially for use on storage-battery charging outfits on or for automobiles, and other small storage-battery installations where it is desired or is necessary to use a single instrument to indicate both volts and amperes. It indicates the charging or discharging current, and by pressing the contact button, indicates the voltage of the cell or battery.

Fig. 3 shows to one-half actual size the special battery-testing voltmeter. These are provided with a steel point as one of the terminals to facilitate making contact to one of the plates or terminals of the cell to be tested; the other terminal consists of a flexible lead also provided with a point. They have knife-edge pointers, and are made with the zero in the center, so that the voltage may be read regardless of the polarity.

A New Dial Decade Portable Testing Set.

A high-grade dial decade portable testing set, weighing but eight pounds and measuring when closed only 7⅜ by 8¾ by 4½ inches, is being placed upon the market by the Leeds & Northrup Company, of Philadelphia, Pa. The set has been so designed, and it will be manufactured in such quantities that it has been possible to place a price upon it which is remarkably small for an instrument of this character. This set, as shown in the illustration, is adapted for resistance measurements within the range of the Wheatstone bridge. By means of two small but substantial double-throw switches, the internal connections are changed for the Murray or Varley loop tests used in locating grounds, crosses, etc., on lines and cables. The set may also be used in locating broken wires.

Dial Decade Portable Testing Set.

Besides its small size, light weight and low price, there are several other features which make this set a radical improvement over other types. The ratio and rheostat resistances are controlled by dial switches, the contacts being entirely inclosed and thus protected against dust and dirt. The contacts are readily accessible, however, for inspection.

The ratio resistances are controlled by a single dial switch, thus eliminating the confusion often occasioned in other types of sets due to uncertainty as to whether the ratio value to be used is to be taken as the A arm value divided by the B arm value, or the reverse.

All resistances are wound upon metal spools, Such resistances are more stable in their adjustment than those wound upon wooden spools. Further, metal-spool resistances will carry more current than wooden-spool resistances, and therefore the coils in this set are less liable to be burned out because of excessive currents than are those in sets using wooden spools. The rheostat coils are guaranteed accurate to one-tenth of one per cent and the ratio coils to one-twentieth of one per cent.

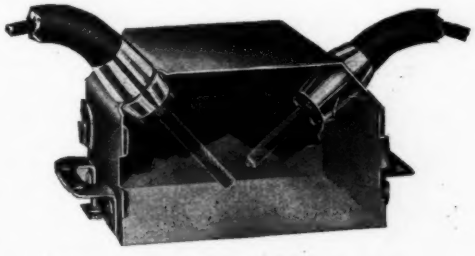
The galvanometer is of a new type, having a guaranteed sensitivity of one megohm. The sensitivity of other galvanometers for similar purposes varies from one-half to three-quarter megohm. The moving system is contained in a separate unit which may be readily removed should the system become damaged due to a fall or excessive jar. This unit may then be returned to the makers by parcel post, thus saving express charges on the entire instrument.

A battery of four cells is contained in the instrument. This is easily replaceable. Provision is made for using both external battery and galvanometer, should this be desirable.

The instrument is sold under a positive guarantee covering both material and workmanship for a period of one year. It is so designed and constructed, however, that it should remain in first-class condition indefinitely.

Universal Bushing for Flexible Conduit.

A new type of bushing for anchoring circular loom and similar flexible fiber tubing to outlet and switch boxes has been placed on the market by the New Process Specialty Company, 709 M. & M. Bank Building, Milwaukee, Wis. This bushing is called the Universal bushing. Its construction is made clear by the accompanying illustration. It consists of a split sleeve with tapering ends and a circumferential groove. The bushing is very readily installed in either of the two ways shown in the illustration. It is necessary merely to force out the knockout, slip the bushing over the tubing to the desired location and then force both into the knockout. Since the bushing is of spring material it is clamped in place and at the same time exerts sufficient pressure upon the tubing to firmly hold the latter in place.



Universal Bushing for Flexible Conduit.

Universal bushings are made in two sizes, the No. 1 bushing which is illustrated, fits any five-eighth-inch knockout and the No. 2 size fits any half-inch knockout.

Electrochemical Treatment of Timber.

A Frenchman has invented a process for electrochemically treating timber which he calls electrocuring. It is claimed to thoroughly season the timber over night. The timber is submerged in a solution containing 10 per cent borax, 5 per cent resin and a small trace of soda. Lead-plate electrodes are placed on opposite sides of the timber and when the current is applied it draws the sap out of the wood cells and replaces it with the borax and resin.

M. & M. Uni-Sectional Steel Wall Boxes.

Wherever a number of flush-wall switches or receptacles have to be installed side by side gang wall boxes insure proper alinement and neat finished work. Frequently, however, it is impossible to determine beforehand whether the switches are to be installed singly or side by side and therefore the wireman is put to the trouble of making numerous trips to and from the shop to get the requisite number of single and gang boxes from a necessarily considerable stock that must be kept on hand. This inconveniene has resulted in the development of sectional wall boxes that can be assembled from single-box units to make up a gang box of any desired size. As a rule such sectional boxes require special end sections and spacers which must be readily available on the job, if much time and labor are to be saved.

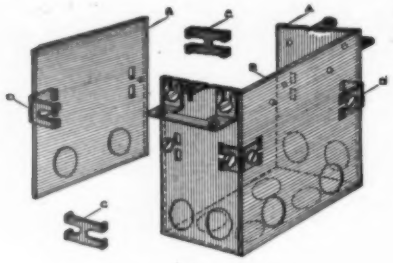


Fig. 1.—Details of Box.

To overcome these disadvantages, the Machen & Mayer Electrical Manufacturing Company, Philadelphia, Pa., has placed on the market a new type of sectional box known as the M. & M. Uni-Sectional steel wall box. The principle of its construction is made clear in Fig. 1. The boxes are made in single units with removable long sides *B*. It is necessary to bring to the job merely as many single boxes as there are switches or receptacles to be installed. If these are to be assembled into a gang of any number of units, it is conveniently and quickly done by removing the adjacent sides *B* along with their corner-connectors *D;* this is done by merely loosening the screws in these connectors without taking them out. The boxes are then joined together by means of section-connectors *C*, two of which are furnished with each single box. The sections snap together without trouble since they are all made with accurate dies. Any sides *B* that are left can be later joined to the sections *A*, which can be procured separately with two connectors *C* for each; thus new single boxes are readily built up. If desired, a few of the complete middle sections *A* can be taken along and the gang boxes built up with them directly.

Fig. 2.—General View of Type L Box.

Two types of Uni-Sectional boxes are made. The type L box, Figs. 1 and 2, is three inches deep and is provided with 12 knockouts, if it is to be used with circular loom; if used with rigid or flexible metallic conduit, only 7 knockouts are arranged for. The type S box, Fig. 3, is two and one-half inches deep and intended to be used particularly in wiring old buildings. It cannot be used for rigid conduit. The beveled corners facilitate its use. All of the boxes have reversible and sliding ears to adjust the box to any thickness of plaster. The boxes are in accord with the National Electrical Code.

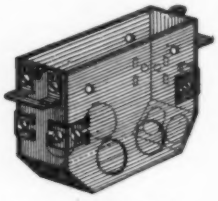


Fig. 3.—Type S Box.

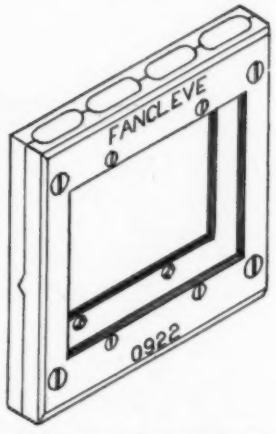
A New P. & S. Socket.

A new socket, a view of which is shown herewith, has been placed on the market by Pass & Seymour, Incorporated, Solvay, N. Y. As shown, it consists of a porcelain body, which is of such construction that it can stand considerable hard usage and exposure to fumes and gases. The body of the sockets has a groove for the attachment of shade-holders. The cap is a three-eighths-inch aluminum cap. This socket fits very nicely with the interchangeable line of P. & S. sockets and receptacles; thus the body can be changed to one of the key type and the cap can be replaced by several designs or by porcelain bases for various methods of installation.

Porcelain Socket with Aluminum Cap.

Fancleve Switch Adapter for Metal Molding.

The Fancleve Specialty Company, Boston, Mass., has added to its extensive line of molding fittings an adapter or switch mat for metal molding that is made in two, three, and four-gang sizes, and is used to transfer the circuits controlled by originally concealed switches to new locations by use of metal molding on the surface. These mats or adapters are composed of an upper and a lower deck. The lower deck is drilled so that it is attached to the original concealed box by the same screws that confine the original switches within the concealed box. These switches may be remounted on the upper deck of the mat or adapter. The top of the adapter has more molding entrances than the switch capacity, while the bottom has molding entrances, or ports, equal to the switch capacity. These are provided with removable seals so that any port may be used or closed up and the box may be inverted to suit the molding requirements.



Switch Adapter for Metal Molding.

Utilities Power Plant at Tuscaloosa.

The Birmingham-Tuscaloosa Utilities Company has let a contract to the General Electric Company for the equipment of its new power plant at Tuscaloosa, Ala. The company is a subsidiary of the Birmingham, Ensley & Bessemer Railroad Company, which operates electric lines in and around Birmingham.

A Government Telephone Factory.

The British Post Office Department is building a factory at Birmingham, England, where about 1,000 men will be employed making telephones and certain telephonic equipment for the country's telephone system, which is now a Government monopoly.

Current Electrical News

LIGHTING AND POWER.

(Special Correspondence.)

ZEANDALE, KANS.—Electric lights will be established here. Address the city clerk.

ST. GEORGE, KANS.—Electric lights will be established here. Address the city clerk.

REYNOLDS, N. D.—This city has decided to install an electric light plant in the near future.

CHERRYVALE, N. C.—The Council is planning to install a lighting plant. Address the mayor.

TROPICO, CAL.—The Pacific Light & Power Company has been granted a 40-year franchise in this city.

ROSEAU, MINN.—The Council will build a light and water system this summer. Address the city clerk.

WILLOW GLEN, CAL.—The Council is planning to improve the city lighting. Address Frank Wolfe for particulars.

LAS CRUCES, N. M.—The Las Cruces Electric Light & Ice Company will install a 15-ton ice machine in its factory here.

HOOPESTON, ILL.—The Hoopeston Electric Light Company will build a transmission line from Rossville to Alvin. Z.

LOS ANGELES, CAL.—Property owners along Olive Street have been granted permission to install an ornamental lighting system.

HOOPESTON, ILL.—The Hoopeston Electric Light Company is contemplating building a transmission line to Ambia, Ind. Z.

PASADENA, CAL.—The City Council has ordered that ornamental lighting posts be furnished and installed along Las Robles Avenue.

FONTANELLE, IOWA.—$22,000 in bonds have been voted for a light and water system. Address the city clerk for further particulars.

ELGIN, ILL.—John S. Russell, commissioner of public property, plans extensions of the ornamental lighting system on several streets. Z.

SAULT STE. MARIE, MICH.—The Lake Superior Power Company has arranged the financing of a complete rehabilitation of its system.

URBANA, ILL.—The Urbana Park Commission contemplates installing an electric-light plant to light Crystal Lake, Leal and Carl Parks. Z.

CLINTON, IND.—The Clinton Gas Company's proposed extension of its service and rebuilding of the local plant on a large scale is now assured.

BIG SPRING, TEX.—The West Texas Electric Company will install additional machinery and equipment in its electric light and power plant here. D.

DODGEVILLE, MICH.—The business men of Dodgeville have gotten up a petition asking for a lighting system for the main thoroughfare.

MATTOON, ILL.—The Central Illinois Public Service Company of Mattoon has been granted a franchise to sell light and power in Brocton. Z.

ELMA, WASH.—The Elma Light & Power Company has been granted a new franchise, as its bonds could not be sold under the conditions of the old one.

CAMERON, TEX.—The Cameron Water Power & Light Company will erect a pumping station and make other improvements to its waterworks system.

SPOKANE, WASH.—The Grauman Walkers Printing Company will use electric power throughout its new $50,000 building, for which Architect Keith L. Whitehouse is preparing plans.

DIXON, ILL.—A committee selected to secure funds announces that enough money will be raised to install 40 ornamental lights in the down-town district. Z.

QUASQUETON, IOWA.—This town has approved the proposition to build and operate an electric light and water plant. Address the town clerk for desired information.

SYRACUSE, N. Y.—The Syracuse Lighting Company has been granted authority to issue bonds in the amount of $239,000 for extensions and improvements.

ANTIGO, WIS.—The residents are planning to establish an ornamental lighting system on Superior Street. Address the city clerk for further particulars.

MARYSVILLE, CAL.—The Supervisors of Yuba County have accepted the bid of the Great Western Power Company for a franchise to extend its lines in the county.

CEDAR FALLS, IOWA.—The City Council has instructed the city engineer to prepare plans and specifications for an electric light plant. Address the city clerk in regard to the matter.

MARYSVILLE, CAL.—Bids will be received up to May 19 for the sale of a franchise applied for by the Oro Electric Corporation, to transmit electricity along certain streets in the city.

SPRINGFIELD, O.—The Springfield Light, Heat & Power Company contemplates installing 7,000 feet of underground conduits in the center of the city. Ware Parsons is general manager. Z.

COLUMBUS, N. M.—C. E. Cook, of El Paso, has been granted a franchise by the City Council for constructing a waterworks system and installing an electric light and power plant here. D.

FRANKFORT, S. D.—More than $4,300 of the required $5,000 for installing an electric-light system here has been subscribed and it is expected the work of installing the system will soon commence.

UNON CITY, IND.—The Union City Electric Company has been incorporated with a capital stock of $100,000 to operate public utilities. The directors are J. S. Dales, Robert Cass and others.

PATERSON, N. J.—The Market Street Business Men's Association has approved a plan for street lighting which will cost $3,000. The Board of Public Works will have to pass upon it before letting the contract.

CONWAY, ARK.—The superintendent of the city electric light plant is advertising for bids for duplicate machinery for the light plant. The estimated cost of these supplies and extensions amounts to $10,000.

ROGERSVILLE, TENN.—The Rogersville Hydro-Electric Company has been incorporated with a capitalization of $5,000 by J. E. Miller and others. The company will build an electric light and power plant on Big Creek, near Rogersville. G.

ALTOONA, PA.—The various public service corporations maintaining wires, together with the municipality itself, have planned a considerable amount of underground work for the coming summer. The city clerk has charge of the matter.

BISMARCK, ILL.—Residents of Bismarck are contemplating the installation of an electric-lighting system and have under consideration a plan to secure power from the Hoopeston Electric Light Company of Hoopeston.

STOCKTON, ILL.—The Stockton Electric Company has been incorporated with a capital stock of $25,000 to operate a heat, light and power plant. The incorporators are John W. Sayer, Harrison A. Smith and C. H. Rinderbach.

LA PORTE, TEX.—Philip J. Pfeiffer, president and general manager of the Jefferson Electric Company of Detroit, Mich., expects to immediately commence the erection of an electric-light and ice plant.

IDLEWOOD, O.—On April 30 bids will be received for furnishing the necessary labor and materials for lighting streets, roads, avenues, alleyways, bridges, etc., with 25 or more electric arc lamps. Address the village clerk.

CORNING, N. Y.—Corning Light & Power Corporation has been incorporated with a capital stock of $500,000 to manufacture and supply light and power. The incorporators are Daniel J. Creem, Clinton J. Rossiter, John McNamee and others.

WHITEHALL, MICH.—To produce and sell electricity in the northern part of Muskegon County the Frugale Power Company has been organized here with a capital stock of $20,000, by Frank H. Speese, Martin W. Cumford and others.

NEWARK, N. J.—The Tri-County Power & Traction Company has been incorporated with a capital of $150,000 to engage in electric light and power operations. George H. Williams, George G.

Teller and Wilber F. Brown are the incorporators. A.

WEST LEBANON, IND.—The Council has granted a 20-year electric franchise to William Hunter, Charles W. Amos and others. Work of installing the plant is to begin at once and an effort will be made to have it in operation by July 1.

WARSAW, ILL.—It is reported that Stone & Webster will expend $20,000 in improvements for the electric light plant which they recently purchased here. A $5,500 brick substation will be erected. An ornamental lighting system will be installed on Main Street. Z.

PENN GROVE, N. J.—The Board of Public Utility Commissioners has approved of ordinances granting the Penn Grove Electric Light, Heat & Power Company permission to install electric systems and operate in Upper Penns Neck and Oldsman Townships. A.

RIVERSIDE, CAL.—At a recent meeting of the Board of Public Utilities, plans for a new substation at Arlington to handle the power delivered to the city by the Southern Sierra Power Company were submitted, and numerous extensions to the lighting system were granted.

AUGUSTA, KANS.—The proposition to build a new municipal electric lighting plant carried at the recent election. The city has $8,000 in the treasury and will issue bonds for $5,000 more. Work on the new plant will be commenced at the earliest possible moment.

CLEVELAND, O.—The Cuyahoga River Power Company is contemplating plans for harnessing the Cuyahoga River and making it furnish power and light for municipalities along its route. The company has acquired the water rights during the past six years.

FARMINGTON, ILL.—The Farmington Light & Power Company has secured contracts to light business houses and residences in Fiatt and to furnish power for the Fiatt mine and its local elevator. Extension will be made of the transmission line which runs from Cuba to Fairview.

SAN BERNARDINO, CAL.—The Empire Water Company is preparing to install an immense hydroelectric plant on Coyote Creek in the San Bernardino mountains and has made application to the State Railroad Commission for authority to issue bonds in the sum of $200,000.

KEOKUK, IOWA.—Keokuk will install a "Great White Way" lighting system on Main Street. The City Council passed an ordinance obligating the city to care for the system. The Keokuk Electric Company will install steel poles and the property owners will bear the cost of installation.

VANCOUVER, B. C.—Property owners on half a dozen streets are seeking to have ornamental brackets for luminous arc lamps installed by the city instead of Tungsten lamp standards. The installation of each light will cost about $218. City Electrician Fletcher has charge of the matter. O.

YONCALLA, ORE.—E. S. Benefiel, of Paisley, Ore., has made arrangements to supply this city with electric light. The plant will be erected on Elk Creek, near Drain, and construction work is to be started in the near future. A 6,600-volt conductor will be used between this place and the plant. O.

PORTLAND, ORE.—The City Executive Board instructed City Auditor Barbour to advertise for bids at once for the lighting of the streets and public buildings of Portland during the next three or five years. Separate bids will be asked for a three-year contract and for a five-year contract, same to commence January 1.

ROCHESTER, MINN.—At the annual meeting of the Utility Board the extension of the present cluster lighting system in the business section was favored by the Board and Superintendent H. C. Swanson was instructed to prepare an estimate of cost to be submitted to the Board which will later be presented to the Council.

KENNEY, ILL.—West & Veall, of Mt. Pulaski, have presented an ordinance granting them a franchise to sell light and power in Kenney. If the franchise is granted the company will buy the local plant, shut it down and run a transmission line from Mt. Pulaski to Kenney, which will also give service to Chestnut and Latham. Z.

WINDSOR, ONT.—Windsor's lighting plant will be improved according to plans of the Lighting Committee. Locations for about 60 new street lights are required in the residential section. The proposal for a "White Way" system on the principal business streets of the city will also be considered when the report of the committee comes before the City Council.

HILLSBORO, ILL.—The City Council has appointed H. S. Hargraves and E. T. McDavid to confer with the Montgomery County Board of Supervisors, in regard to a proposition to install ornamental lights about the Court House square. The City Council intends to change the entire street-lighting system and has asked all property owners to assist them in obtaining a uniform style of lighting. Z.

PEORIA, ILL.—The Central Illinois Light Company has filed articles of incorporation here. The company has been incorporated with a capital stock of $750,000 to operate electric-light plants at Pekin, Washington, Eureka, Farmington, Elmwood, Princeville, Hanna City, Cuba, London Mills and Roanoke. The incorporators are A. D. Furlong, H. T. Willett and P. B. Warren, official of the Springfield Light, Heat & Power Company at Springfield. Z.

HILLSBORO, ILL.—It is announced that the $500,000 increase of capital stock of the Southern Illinois Light & Power Company, formerly the Hillsboro Electric Light & Power Company, will be expended this summer in extending transmission and railway lines. The transmission line will be extended from Morrisonville to Palmer and from Coffeen to Fillmore. An appropriation has been made for a subway in Schram City, which will be a part of the electric railway line from Hillsboro to Nokomis. Z.

DEMING, N. M.—The Federal Light & Traction Company will install two high-pressure boilers with stokers of 350 horsepower each, and a cross-compound Corliss engine direct connected to a 200-kilowatt alternator; motor-driven condenser apparatus and motor-driven feed pumps in its power plant here. It is also constructing a new power-transmission line to a farming community 14 miles east of Deming, where it will construct a substation and build several miles of distributing lines. This company is also reconstructing its ice plant here. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

BLOOMINGTON, ILL.—The wires of the Roberts Telephone Company are to be placed underground.

RIALTO, CAL.—The Home Telephone & Telegraph Company has been granted a franchise in this city.

CAPE MAY, N. J.—The City Council is planning for the installation of a new police call-box system. A.

GENEVA, O.—People's Telephone Company has been incorporated with a capital stock of $50,000.

AURORA, ORE.—The Aurora Mutual Telephone has elected directors and work of construction is to start at once. O.

HILLSBORO, ILL.—The People's Mutual Telephone Company announces that it will build an additional line between Hillsboro and Litchfield. Z.

SUMTER, S. C.—The Sumter Telephone Company has been incorporated with a capital stock of $1,000, by A. G. Bean, G. A. Scoville and others.

SIERRA MADRE, CAL.—The Sierra Madre Telephone & Telegraph Company has applied for permission to issue $1,000 in stock for the purpose of installing new equipment.

NASHVILLE, TENN.—The Home Telephone and Telegraph Association has been incorporated with a capital stock of $2,000, by B. B. Brown, Mrs. G. W. Brown and others.

CRYSTAL FALLS, WASH.—Little Pend Oreille Telephone Company has been incorporated with a capital stock of $5,000 by O. E. Battman, Thomas Donica and others.

ANACORTES, WASH.—The Pacific Telephone & Telegraph Company is making preparations to install a 25-pair double-armored cable between this place and Guemes Island, to cost about $5,000. O.

LA GRANDE, ORE.—This place has granted a franchise to the Eastern Oregon Co-operative Telephone Company to enter the city. Poles have already been set to the city limits and the work of extending the line into the city will be started at once. O.

MISSOULA, MONT.—George L. Pavy, manager Mountain States Telephone Company, announces that if Government permits can be secured his company will construct 150 miles of pole line on the Flathead reservation, in this state. The head office of the company is in Salt Lake City. O.

ABINGDON, ILL.—The Home Telephone Company has asked the City Council for a 25-year extension of its franchise. The company proposes to erect a new exchange building, install a new switchboard and place its wires underground in the business section of the city.

SUPERIOR, ARIZ.—F. E. Webster, superintendent of telephones for the Ray Consolidated Copper Company, has been looking over plans for the erection of a telephone system for the Calumet & Arizona Mining Company, connecting its mines here with the Ray Company's system at Ray.

GALESBURG, ILL.—District Manager F. W. Kelley of the Central Union Telephone Company has received notice that $50,000 worth of improvements will be made on the company's lines between this city and Quincy. The work of rebuilding these lines will probably begin about the first of June.

HELENA, MONT.—The building program of the Mountain States Telephone & Telegraph Company for this city during the present year includes doubling of the present plant at an estimated cost of $140,000. The cable system is to be reconstructed throughout and doubled in capacity. Of the amount allotted to this city, $45,000 is to be spent on extending the underground system to cover practically the entire business district and portions of the residence district. Considerable toll-line work is also planned, most of it out of this city. The biggest toll-line job will be the construction of a loaded-copper circuit from Helena to Billings. O.

ELECTRIC RAILWAYS.

(Special Correspondence.)

PHILADELPHIA, PA.—E. W. Clarke & Company, of this city, plans an extension of its line to Fosterburg.

CORONA, CAL.—Bids will be received up to June 3 for a 50-year franchise in this city, applied for by the Pacific Electric Company.

JAMESTOWN, N. Y.—A 50-year franchise has been granted to the Jamestown Street Railroad Company to operate a line which is known as the Willard Street extension.

TRENTON, N. J.—The Trenton & Mercer County Traction Company is planning to rebuild sections of its track and overhead trolley equipment within the city limits. A.

UVALDE, TEX.—The Uvalde & Leona Interurban Railway Company will extend and improve its line. It is reported that one of the extensions will run to Batesville, about 30 miles. D.

SCHENECTADY, N. Y.—The Schenectady Railway Company plans to expend about $350,000 for improvements to its system. A 12-mile extension will be made to South Schenectady and Carman.

BELOIT, WIS.—The Beloit, Clinton & Delavan Railway Company has filed articles of incorporation with a capitalization of $50,000. It is the purpose of the company to build an interurban railway to Lake Delavan.

FOREST GROVE, ORE.—A move is on foot by the Commercial Club of this place to procure the extension of the Oregon Electric railroad from this place to beyond Gales Creek, where it would be joined to the United Railways line. O.

HAGERSTOWN, MD.—It is stated that John R. Bear, of Philadelphia, and L. O. Davis, of Harrisburg, promoters, are investigating the probable cost of constructing a trolley line between this city and Clearspring, a distance of 12 miles.

PORTLAND, ORE.—As a result of the inspection recently made by C. M. Clark, chairman of the Executive Board of the Portland Railway, Light & Power Company, orders were given for the immediate electrification of the line from Gresham to Bull Run, a distance of about 12 miles. O.

SEGUIN, TEX.—F. C. Weinert and associates have under consideration the proposition of constructing an interurban electric railway between Seguin and Staples, 18 miles. The project is also being agitated by business men of Staples and the land owners along the route of the proposed line. D.

SOUTH VANCOUVER, B. C.—The British Columbia Electric Railway Company is arranging for the erection of a substation at a cost of about $90,000. The equipment will consist of three motor generator sets of 1,000-kilowatt capacity each, and transforming equipment of 7,000-kilowatt capacity. O.

SEWAREN, N. J.—The Public Service Railway Company is planning for the construction of a new line between Sewaren and Port Reading, and to the outskirts of Roosevelt; right of way is now being acquired. The line will be used in connection with a fast traction service between Perth Amboy and Newark. A.

LOS ANGELES, CAL.—The Railroad Commission has authorized the Pacific Electric Company to issue bonds to the amount of $6,839,000, the proceeds to be used for extensions and improvements to the company's railway system radiating from Los Angeles.

RALEIGH, N. C.—The Albemarle & Whitney Street Railroad Company has been chartered here with a capital stock of $100,000 for the purpose of constructing and operating an electric railway. The company is also authorized to do a lighting and telephone business. T. H. Vanderford, of Salisbury; J. H. Moss and L. L. Cotton are named among the incorporators.

WILMINGTON, DEL.—The St. Paul Southern Electric Railway Company has filed articles of incorporation with a capitalization of $5,000,000. Philip Heinz, of Rochester, is president of the new company. L. F. Irish, of Pine Island, and Irving Todd, of Hastings, are the other directors. The officers expect to run the first car between St. Paul and Hastings July 1.

BRYAN, TEX.—The Bryan & Central Texas Interurban Railway Company has been incorporated with a capital stock of $85,000. The purpose of the corporation is to construct, maintain and operate an interurban railway between Bryan and Wilcox, a distance of 32 miles. The incorporators are O. E. Gammill, J. E. Butler, L. M. Hewitt, W. E. Saunders, J. W. English, A. W. Wilkerson and others.

NAUVOO, ILL.—The Lomax Terminal Railroad Company has been incorporated with a capital stock of $25,000 to construct a railroad from Nauvoo through the counties of Henderson and Hancock to Stronghurst, in Henderson County. The incorporators and directors are William T. Love, J. F. Smith, C. H. Kisner, H. W. Beardsley and L. O. Beardsley, all of Lomax. Z.

GLOBE, ARIZ.—The Stone & Webster Engineering corporation of Boston, Mass., has been investigating the situation here with a view of constructing an interurban electric railway between Globe and Miami and Live Oak. It is stated that the survey for the proposed line will soon be made and that construction work will be started within a short time after the preliminary arrangements have been finished. D.

LOUISVILLE, KY.—The Louisville & Interurban Traction Company may extend its Lagrange division shortly through Trimble County to a point directly opposite Madison, Ind., in the center of a rich fruit-raising and truck-farming country. Tens of thousands of dollars are offered by residents of that section for the extension of the line, for while Madison and the territory surrounding it have prospered for years because of river transportation facilities, there has never been a railroad connection of any kind. G.

NEW INCORPORATIONS.

CHICAGO, ILL.—The Research Company has been incorporated with a capital stock of $100,000 to manufacture mechanical and electrical devices. The incorporators are Forest E. Marsh, Edward E. Gray and Louise H. Marsh. Z.

CHICAGO, ILL.—The Ideal Novelty & Lamp Manufacturing Company has been incorporated with capital stock of $2,500 to manufacture lighting devices and equipment. The incorporators are Arthur F. Bond, Oscar J. Bond and Jerome Levinson. Z.

PROPOSALS.

ELECTRIC-LIGHTING FIXTURES.—The Board of Education of Perth Amboy, N. J., of which Jesse Colyer is secretary, will receive bids until May 1 for the electric lighting fixtures for the new addition to the Grammar School, Manual Training Building and heating plant.

INTERIOR-COMMUNICATING CABLE.—Sealed proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D .C., until May 13, for furnishing 1,500 feet of interior-communicating cable to be delivered to the Navy Yard, Brooklyn, N. Y., as per Schedule 5380.

SPECIAL LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until May 15, for the special lighting fixtures for the post office at Washington, D. C., in accordance with drawings and specifications, copies of which may be had at the discretion of the Supervising Architect.

WIRE CABLE.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until May 2 for furnishing wire cable as per Canal Circular 771. Blanks and specifications may be obtained from the General Purchasing Officer or from the Assistant Purchasing Agents in any of the large cities.

ELECTRIC ELEVATOR.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until May 5, for an electric freight elevator in the post office and court house at Philadelphia, Pa., in accordance with specifications, copies of which may be obtained from the custodian of the site or the Supervising Architect.

ELECTRIC MACHINE TOOLS.—Sealed proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 13 for furnishing one electric conveyor, to be delivered at the Navy Yard, Washington, D. C., as per Schedule 5365; and for one motor-drive planer, to be delivered at the Navy Yard, Newport, R. I., as per Schedule 5364.

ELECTRIC CONDUIT AND WIRING AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until May 27, for furnishing the electric conduit and wiring and interior lighting fixtures of a one-story building for the post office at Marlin, Tex.; until May 28 of a three-story building for the post office at Pocatello, Idaho; and until May 29 of a two-story building for the post office at Morristown, Tenn. Drawings and specifications may be obtained from the custodian of the sites or from the Supervising Architect.

FINANCIAL NOTES.

At the annual meeting of the Pacific Gas & Electric Company directors and officers were re-elected. Stockholders unanimously ratified the proposed issue of $5,000,000 six-per-cent debentures, to be offered pro rata to stockholders, proceeds to be used in construction work.

The Cleveland Electric Illuminating Company has given holders of the common and preferred stocks of the company right to subscribe to new common stock at par to the extent of 18 per cent of present holdings. The company is putting out about $1,300,000 of new common stock, which will make its capitalization consist of $8,700,000 common and $800,000 preferred stock. The rights accrue to holders of date of April and expire May 1, when payment for the new stock must be made.

At a special meeting of citizens of the U. S. Light & Heating Company, J. Allan Smith, formerly general manager, was elected president, to succeed E. W. Pye, who resigned some time ago. Charles A. Starbuck, president of the New York Air Brake Company, was elected chairman of the Board, a new position. F. P. Frazier was elected a vice-president, succeeding Mr. Starbuck. W. P. Hawley was also the Board, a new position. F. P. Frazier man was made general manager, succeeding J. Allan Smith, and W. S. Crandall was re-elected secretary and treasurer.

The Cloverdale Light & Power Company, and the California Telephone & Light Company, with headquarters in Santa Rosa, Cal., have applied to the Railroad Commission for an order empowering the former to sell its property to the latter. The California Telephone & Light Company also asked for authority to create a bonded indebtedness in the amount of $5,000,000, and to sell at this time bonds to the amount of $3,500,000. It is proposed that the proceeds from the $3,500,000 in bonds be used to discharge existing obligations in the amount of $228,000; to purchase property of the Cloverdale Light & Power Company for $75,000, and to make improvements to cost $17,000.

Dividends.

American Railway Company; dividend of 1.75 per cent on the preferred stock (full paid shares), issued and outstanding, payable May 15 to stock of record April 30.

Cities Service Company; regular monthly dividends of one-half of one per cent on the preferred stock and five-twelfths of one per cent on the common stock, payable May 1 to stock of record April 15.

Connecticut Railway & Lighting Company; the regular quarterly dividends of 1 per cent on both common and preferred stocks, payable May 15.

Crocker-Wheeler Company; regular quarterly dividends of 1.75 per cent on the preferred and 1.5 per cent on the common, payable April 15 to stock of record April 4.

Cumberland County Power & Light Company; a quarterly preferred dividend of 1.5 per cent, payable May 1 to stock of record April 21.

Easton Consolidated Electric Company; a semi-annual dividend of two per cent, payable May 1 to stock of record April 19.

Guanajuato Power & Electric Company; a quarterly dividend of 1.5 per cent, payable May 1 to stock of record April 17.

Houghton County Electric Light Company; semi-annual dividends of three per cent on preferred stock, and 2.5 per cent on common stock, payable May 1 to stock of record April 21.

Lowell Electric Light Corporation; a quarterly dividend of two per cent, payable May 1 to stock of record April 22.

National Carbon Company, regular quarterly dividend of 1.75 per cent on preferred, payable May 15 to stock of record May 5.

Pacific Gas & Electric Company; regular quarterly dividend of 1.5 per cent on preferred, payable May 15 to stock of record April 30.

Railways Company General; the regular quarterly dividend of one per cent.

Sierra Pacific Electric Company; a quarterly preferred dividend of $1.50 per share, payable May 1 to stock of record April 23.

Toledo & Bowling Green Railway & Light Company; a quarterly preferred dividend of 1.25 per cent, payable May 1 to stock of record April 21.

West Penn Railways Company; regular quarterly dividend of 1.25 per cent on the preferred stock, payable May 1 to stock of record April 23.

Reports of Earnings.

MICHIGAN TELEPHONE COMPANY.

The report of the Michigan State Telephone Company for the year ended December 31, 1912, shows net earnings of $947,485, a decrease of $56,484. The income account compares as follows:

	1912	Increase
Gross earnings	$5,193,923	$551,911
Operating expenses, maintenance, depreciation and taxes	4,246,438	608,395
Net earnings	$ 947,485	*$56,484
Interest	593,129	77,903
Balance	$ 353,555	*$134,387
Preferred dividend 6 per cent	136,995	.....
Common dividends	216,156	*25,939
Total dividends	$ 353,151	*$25,939
Surplus	$ 404	*$108,448

*Decrease.

The increase in the number of stations owned during the year was 10,829, making a total of 171,977. Substantial additions were made to the physical property at a total cost of $1,133,215. In addition to this the company acquired the properties of the Home Telephone Company of Michigan and various other companies throughout the state.

HUDSON'S TUBES EARNINGS.

The report of the Hudson & Manhattan Railroad Company for the year ended December 31, 1912, shows net earnings of $3,094,405, an increase of $497,745. A heavy increase in miscellaneous charges, however, resulted in a deficit for the year of $74,532, as compared with a surplus of $8,869 in 1911. The operations of the Hudson Terminal buildings in 1912 proved more profitable than in the previous year, the net income from this source amounting to $946,369, an increase of $35,708.

The income account for the fiscal period compares as follows:

	1912	Increase
Gross revenue	$5,334,660	$695,196
Oper. expenses and taxes.	2,240,255	197,451
Net earnings	$3,094,405	$497,745
Int. on bonds outstndg...	2,943,196	*1,356
Less int. chgble. constr...	64,114	*576,513
Int. chargeable against inc.	2,879,081	575,157
Other charges	289,855	5,991
Total deductions	$3,168,936	$581,148
Deficit	74,531	83,403

*Decrease.

PHILADELPHIA ELECTRIC COMPANY.

The report of the Philadelphia Electric Company, for the year ended December 31, 1912, shows net earnings of $1,666,189, against $1,403,341 in 1911. This was equal to 9.52 per cent on the capital stock paid in. The income account compares as follows:

	1912	1911
Gross	$7,051,497	$6,425,590
Oper. exp. & fixed chgs.	5,385,308	5,021,849
Net income	$1,666,189	$1,403,341
Dividends	974,668	899,724
Surplus	$ 691,520	$ 504,007
Previous surplus	1,127,393	623,375
Total surplus	$1,818,913	$1,127,393

UNITED LIGHT COMPANY.

The consolidated income account of the United Light & Railways Company and subsidiaries in February shows an increase in surplus, after charges for February, of $23,244. For eight months there was a gain in surplus after charges of $216,838. Following are the comparative figures for February, and the eight months ended February 28, 1913:

	1913	1912	Increase
February gross.	$ 455,959	$ 402,530	$ 53,429
Net after tax...	181,272	155,329	25,943
Surplus after charges	85,810	62,566	23,244
Eight months gross	3,708,505	3,324,629	383,876
Net after taxes.	1,595,612	1,372,102	223,510
Surplus after charges	860,255	643,416	216,838

The earnings from subsidiary companies and other sources, accruing to securities of United Light & Railways for eight months ended February 28, 1913, were $886,777, out of which were paid expenses of $49,422 and interest charges of $223,989, leaving net earnings applicable to stocks of $613,365. Dividends on first preferred stock was $208,077 and on second preferred stock $64,431, leaving a surplus of $344,856 for the common stock outstanding for the eight months.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	April 21	April 14
American Tel. & Tel. (New York)	129½	131⅜
Commonwealth Edison (Chicago)	135¾	138
Edison Electric Illuminating (Boston) (Ex. dividend)	277	280
Electric Storage Battery common (Philadelphia)	50½	50½
Electric Storage Battery preferred (Philadelphia)	50½	50½
General Electric (New York)	139½	140⅝
Kings County Electric (New York)	129	129
Manhattan Transit (New York)	1⅝	1⅝
Massachusetts Electric common (Boston)	18½	18¼
Massachusetts Electric preferred (Boston)	77¼	77
National Carbon common (Chicago)	116½	116
National Carbon preferred (Chicago)	116	116
New England Telephone (Boston)	149	149
Philadelphia Electric (Philadelphia)	22¾	22¾
Postal Telegraph and Cables common (New York)	83	82
Postal Telegraph and Cables preferred (New York)	67	66
Western Union (New York)	66¼	68¼
Westinghouse common (New York)	63⅞	64½
Westinghouse preferred (New York)	118½	116

*Last price quoted.

UNITED RAILWAYS INVESTMENT.

The United Railways Investment Company has issued its pamphlet report for the year ended December 31, 1912. The profit and loss account compares as follows:

	1912.	1911.
Dividends, stock owned.	$1,984,172	$2,044,672
Interest on loans, etc..	†276,078	91,862
Total income	2,260,250	2,136,536
Charges, gen. exp., etc.	1,270,605	1,295,709
Net income	*989,645	840,827
Previous surplus	3,110,230	2,368,778
Adj. credit	156,667	.....
Discount on notes.....	.....	99,375
P. & P. surplus.....	4,256,542	3,110,230

†Includes item "other interest (including collections deferred from prior gross)" $197,078.

*Equal to 6.18 per cent earned on $16,000,000 preferred stock, as compared with 5.25 per cent earned on same stock previous year.

BELL TELEPHONE SYSTEM IN UNITED STATES.

American Telephone & Telegraph Company and associated holding and operating companies in the United States, not including connected independent or sublicensee companies, report earnings for two months ending February 28, 1913, as follows:

	1912	1913
Gross earnings	$31,149,496	$34,425,357
Expenses—		
Operation	$10,230,843	$11,842,290
Current maintenance	4,905,877	5,133,361
Depreciation	5,332,335	5,888,879
Taxes	1,651,890	1,758,765
Total expenses ...	$22,120,945	$24,623,295
Net earnings.....	$ 9,028,551	$ 9,802,062
Deduct interest.....	2,180,092	2,749,241
Balance net profits...	$ 6,848,459	$ 7,052,821
Deduct dividends (estimated for 2 months.	4,866,913	5,035,527
Surplus earnings	$ 1,981,546	$ 2,017,294

AMERICAN GAS AND ELECTRIC SUBSIDIARIES.

The following subsidiaries of the American Gas & Electric Company report earnings for February, 1913, and the twelve months ending on February 28, 1913:

ATLANTIC CITY ELECTRIC.

	1913.	1912.
February gross	$32,170	$30,596
Net	13,304	13,001
Surplus after charges	4,473	4,201
12 months' gross.....	$455,709	$426,593
Net	262,901	241,236
Surplus after charges.....	158,844	144,362

CANTON ELECTRIC.

February gross	$ 33,983	$ 30,495
Net	17,779	15,873
Surplus after charges.....	13,080	11,117
12 months' gross.....	351,173	316,787
Net	176,162	162,170
Surplus after charges.....	119,493	106,325

MUNCIE ELECTRIC LIGHT.

February gross	$ 39,886	$ 32,044
Net	15,675	13,706
Surplus after charges.....	8,669	7,373
12 months' gross.....	404,959	321,375
Net	171,598	138,770
Surplus after charges.....	88,875	87,075

ROCKFORD ELECTRIC.

February gross	$ 40,269	$ 37,722
Net	20,942	12,274
Surplus after charges.....	13,044	9,432
12 months' gross.....	424,830	392,315
Net	211,305	184,226
Surplus after charges.....	116,738	92,647

SCRANTON ELECTRIC.

February gross	$ 73,984	$ 70,887
Net	46,043	39,206
Surplus after charges.....	32,227	27,651
12 months' gross.....	812,000	744,240
Net	465,968	420,498
Surplus after charges.....	311,504	281,895

WHEELING ELECTRIC.

February gross	$ 24,632	$ 22,396
Net	11,624	11,741
Surplus after charges.....	5,854	8,452
12 months' gross.....	266,604	223,889
Net	120,629	116,999
Surplus after charges.....	56,690	81,399

PERSONAL MENTION.

HOWARD BURTON SHAW, dean of the College of Engineering of the University of Missouri, has been appointed a member of the Public Utilities Commission of Missouri for four years. His associates are John Atkinson, Judge John Kennish and Frank A. Wightman. Dean Shaw was born in Winslow, Me., and received his early education in the public schools of that town. He received the degree of A. B. from the University of North Carolina in 1890, and the degree of B. C. E. in 1891. From 1893 to 1896 he studied electrical engineering at Harvard and received the degree of A. M. in 1894. From 1889 to 1890 he was instructor in mathematics in the University of North Carolina and during the summer of 1891, he was draftsman and chief engineer in the office of the Phoenix Iron Company, Phoenixville, Pa. From 1891 to 1893 he was instructor in mathematics, surveying and drawing in the University of North Carolina. In 1894 he became assistant in the electrical engineering laboratory at Lawrence Scientific School, Harvard University. In 1896 he was employed by the Consolidated Traction Company at Jersey City and Pittsburgh. In 1896 Mr. Shaw became assistant professor of electrical engineering at the University of Missouri, and in 1899 was advanced to the rank of professor. In 1904 he was chosen junior dean of the School of Engineering. He became dean in 1907. He is a member of the Engineers' Club of St. Louis and of Phi Beta Kappa, and is well known among electrical men throughout Missouri.

Howard Burton Shaw.

M. G. CARHART has taken charge of the power apparatus sales department of the Western Electric Company at Seattle, Wash.

E. F. PUTNAM, formerly sales engineer of the Edison lamp works of the General Electric Company, has been appointed commercial manager of the United Electric Light & Power Company, of Greenwich, Conn.

JAMES E. MORROW, manager of the Owensboro Home Telephony Company, Owensboro, Ky., has resigned and has been succeeded by PERCY SHORT, who for several years had been assistant manager of the Paducah Home Telephone Company, Paducah, Ky.

FRANKLIN T. GRIFFITH, general counsel of the Portland Railway, Light & Power Company, Portland, Ore., and recently elected a vice-president of the company, will succeed to the presidency upon the retirement of B. S. JOSSELYN, the present incumbent, in July.

E. B. CRAFT, development engineer of the Western Electric Company, was the speaker of the evening at the 144th meeting of the telephone Society of New York on April 23. His subject was "The Engineering Laboratories of the Western Electric Company, Their Problems and Their Relation to the Telephone Business."

WILLIAM STANLEY, of the General Electric Company, gave a dinner at the Lotos Club, New York, last week in honor of Peter Cooper Hewitt, to which were invited the officials of the research work of the company. The dinner occurred Wednesday evening, and in addition to the host and chief guest, was attended by Elihu Thomson, E. W. Rice, Jr., W. E. Cooldige, Irving Langmuir, E. Weintraub, W. R. Whitney and Albert B. Davis, all of the General Electric Company.

SEYMOUR W. CHENEY has been appointed operating engineer for the La Crosse (Wis.) Gas & Electric Company. Mr. Cheney attended the University of Wisconsin and graduated in 1904, completed post-graduate work in 1905 and in 1912 presented a thesis and received a master's degree in mechanical engineering. He entered the gas and electric business in 1905 as cadet engineer with the Denver Gas & Electric Light Company. In 1906 he was appointed superintendent of distribution of the Lincoln (Neb.) Gas & Electric Company. Later he held a similar position with the Montgomery (Ala.) Light & Power Company. Since 1910 he has been on the engineering staff of the Railroad Commission of Wisconsin, with headquarters in Milwaukee. The La Crosse company is a subsidiary of the American Public Utilities Company.

OBITUARY.

HENRY J. HAIGHT, a retired inventor of electrical apparatus, died on Monday, April 14, in the German Hospital, Philadelphia, Pa. Mr. Haight was 70 years of age.

RICHARD B. ARRINGTON, secretary and treasurer of the Southern Power Company, Charlotte, N. C., died on April 16, at his home at White Plains, N. Y. He was born in Petersburg, Va., 39 years ago. He is survived by his widow, two sons and two daughters.

GEORGE P. BROPHY, a prominent electrical man of Ottawa, Canada, died at his residence in Ottawa of heart trouble in his sixty-fifth year, on Friday, April 4. Mr. Brophy was one of the founders of the Ottawa Electric Railway Company and the Ottawa Electric Company, and superintendent-engineer of the Ottawa river works. He was also a director in the Ottawa Trust & Deposit Company. He assisted in forming the Ontario Graphite Company, the Ahearn Electric Lighting & Manufacturing Company, the Locomotive & Machine Company of Montreal, the Thousand Islands Land Company, the Ontario Smelting, Milling & Refining Company, and other smaller concerns. He is survived by his widow, one son and four daughters.

DATES AHEAD.

Oklahoma Electric Light, Railway and Gas Association. Annual convention, Oklahoma City, May 6-8.

Order of Railroad Telegraphers. Baltimore, Md., May 13.

The Society for Electrical Development, Incorporated. Annual meeting, New York, N. Y., May 13.

National Fire Protection Association. Annual meeting, New York, N. Y., May 13-15.

Association of Railway Telegraph Superintendents. Annual meeting, St. Louis, Mo., May 20.

American Society of Mechanical Engineers. Spring meeting, Hotel Belvedere, Baltimore, Md., May 20-23.

Southwestern Electrical and Gas Association. Annual convention, Galveston, Tex., May 21-24.

Electrical Supply Jobbers' Association. Spring meeting, Congress Hotel, Chicago, Ill., May 26-28.

National District Heating Association. Fifth annual convention, Indianapolis, Ind., May 27-29.

National Electric Light Association. Annual convention, Medinah Temple, Chicago, Ill., June 2-5.

Canadian Electrical Association. Annual convention, Fort William, June 23-25.

Electrical Contractors' Association of the State of Missouri. Annual meeting, St. Louis, Mo., July 12.

National Electrical Contractors' Association. Annual meeting, Chattanooga, Tenn., July 16.

Michigan Section, National Electric Light Association. Annual convention, Ottawa Beach Hotel, Ottawa Beach, Mich., August 18-21.

With the Electrical Manufacturers

J. G. Brill Company, of Philadelphia, Pa., has received an order from the Belt Line Railway to furnish 40 storage-battery cars.

Herbert Laws Webb, consulting engineer, has removed his offices from 35 Old Queen Street, Westminster, London, S. W., to 104 Victoria Street, Westminster, London, S. W., England.

The Electric Storage Battery Company, of Philadelphia, Pa., is contemplating building a new power house for its large manufacturing plant at the corner of Nineteenth Street and Allegheny Avenue, Philadelphia.

American District Steam Company, North Tonawanda, N. Y., has opened a Pacific Coast branch office in the Hoge Building, Seattle, Wash. This will be in charge of Eugene L. Barnes as district manager.

Hotpoint Electric Heating Company, Ontario, Cal., is making an attractive offer to central stations in connection with its special half price on the El Tostovo electric toaster stove that will be offered on its next Hotpoint Day, May 10.

A. Eugene Michel and Staff, advertising engineers, who are handling a number of technical accounts including many manufacturers of electrical and kindred apparatus and supplies, have removed from 22 Park Row into larger offices in the new Woolworth Building, New York City.

The Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa., has issued bulletin No. 530, which describes its new dial decade portable testing set, a description of which appears on other pages of this issue. Copies of the bulletin may be obtained on writing to the company's headquarters.

Crouse-Hinds Company, Syracuse, N. Y., announces that on May 1 its office at Cincinnati, O., will be removed to the twenty-third floor of the tower of the new Union Central Building at the corner of Fourth and Vine Streets. The company also wishes it to be known that the "23" applies to troubles only, which it makes a specialty of relieving.

The Line Material Company, South Milwaukee, Wis., maker of the Kyle line material, has been awarded the contract by the Sanitary District of Chicago for supplying a large number of two, four and six-pin malleable-iron cross-arms and also for supplying malleable-iron lamp brackets of the overhead type. The amount represented by these contracts is in the neighborhood of $30,000.

Mechanical Appliance Company, Milwaukee, Wis., has published booklet No. 151, which describes Watson motor-driven ventilating fans made in sizes from 18 inch to 42 inch for direct-current and single-phase and polyphase circuits. Methods of installation are illustrated and a chart is included for determining fan capacity required for rooms of various sizes and used for various purposes, as moving-picture theaters, garages, billiard parlors, restaurants, schools, etc.

The Lagonda Manufacturing Company, Springfield, O., has issued Bulletin W, devoted to the cleaning of locomotive arch tubes by the Lagonda method. Since these tubes are subjected to extremely high temperatures and the rate of water evaporation in them is very high, scale deposits form quickly and cause considerable damage. The pamphlet describes the special type of tube cleaner manufactured by the company, particularly for use in cleaning these tubes.

The National Quality Lamp Division of the General Electric Company, which has had under construction new headquarters on Noble Road, East Cleveland, for a year and a half, moved to its new plant on Friday of last week. The 36-acre plant will represent an investment of $1,100,000 when completed. Moving from the East Forty-Fifth Street plant to the new location cost the company $5,000. The job was completed in 19 hours, and the employees missed only three hours of working time.

Pawling & Harnischfeger Company, Milwaukee, Wis., has issued bulletin No. 101 describing the P. & H. single-line grab bucket. The bulletin explains the operation of the bucket in detail with the aid of numerous illustrations. The bucket can be readily attached to or detached from the hook of any traveling, locomotive or other crane and does not interfere with its ordinary use. Although used most extensively for handling loose sand in foundries, these buckets find application for a variety of purposes.

Sangamo Electric Company, Springfield, Ill., has issued bulletin No. 35, describing the Sangamo types D and D4 direct-current watt-hour meters. The bulletin comprises 20 pages replete with fine illustrations of these meters and their parts. The bulletin describes the details of the mechanism quite fully and points out the advantages of the construction adopted, which is of the mercury-flotation type. These meters are made for a variety of purposes, including some that impose rather hard service upon the instruments. Ampere-hour meters are also referred to in the bulletin.

Maschinenfabrik Oerlikon, Oerlikon, near Zurich, Switzerland, has issued a collection of nine bulletins, assembled under one cover, devoted to steam turbines and turbogenerators of its design and construction. This composite publication, designated as No. 565, gives a good general survey of the numerous types of these machines, which are made for substantially every class of service to which steam turbines and turbogenerators are applicable. The publication is illustrated with many fine half-tones and line drawings showing details of the mechanism and also typical installations.

H. W. Johns-Manville Company, New York City, has issued a booklet devoted to J-M Mastic flooring for industrial plants. This material is composed of a fine mineral aggregate bonded together by an asphaltic cement or binder. It is elastic, waterproof, not affected by acids, alkalies or brine, non-dust-producing, noiseless, non-slipping, and easily repaired if floor changes are necessary. Mastic flooring is adapted for breweries, canning factories, candy factories, cold-storage plants, dairies, dye houses, laboratories, machine shops, packing plants, railroad stations, school houses, etc.

The Fred J. Meyers Manufacturing Company, Hamilton, O., announces that it was exceptionally fortunate in

having its factory located in a territory beyond the reach of water during the recent floods. It was necessary, however, to close the factory for two weeks in order to assist its employees who had to devote a large part of their time to aiding one another. The members of the company had their homes inundated from nine to eleven feet, and their individual losses were very severe. The factory is running to its capacity at the present time and the company is in good shape to handle all inquiries.

The Smith-Serrell Company, Incorported, 90 West Street, New York, has published bulletin No. 18, describing the Francke flexible coupling. These are for direct connecting of steam and gas engines, steam and water turbines, dynamos and motors, shafting, etc. It is an ordinary flange coupling connected by flexible instead of rigid bolts. The flexible pins are made of tempered steel leaves, held at each end by a keeper, which prevents them from working loose or getting lost and makes of each pin a flexible bolt. The keepers are slotted at each end to engage spring rings, which also fit in a groove in the coupling flanges. Full information will be sent to those interested upon request.

General Electric Company, Schenectady, N. Y., has issued a group of new bulletins devoted to various types of its electrical machinery and apparatus. Bulletin A4084 describes centrifugal compressors that are particularly adapted to electric-motor or steam-turbine drive.—Bulletin A4097 is devoted to the G. E. ventilated-type railway motors. These motors have a definite longitudinal circulation of air throughout the interior of the machine which cools all parts to a degree hitherto impossible and effects a considerable increase in service capacity. These motors can be operated as fully ventilated, semi-ventilated or fully inclosed motors.—Bulletin A4061 describes electric headlights of the luminous-arc and incandescent-lamp types.—Bulletin A4110 deals with cloth pinions, pointing out in detail their construction and their advantages over other types of noiseless gearing.—Bulletin A4102 describes sewing-machine motors for machines of ordinary household size. These motors are mounted on the working surface of the machine, making their installation to any type of machine extremely simple and convenient. They are easily controlled, noiseless and very economical in operation.—Bulletin A4113 describes oil switches for industrial applications involving small capacities. These switches are of the type F, forms P3 and P6.

Record of Electrical Patents.

Issued by the United States Patent Office, April 15, 1913.

1,058,724. Supervisory Signal System. F. W. Cole, assignor to Gamewell Fire Alarm Telegraph Co., New York, N. Y. A code signal is sent over the supervisory circuit to indicate the location of the box from which the fire alarm originated.

1,058,725. Combined Auxiliary and Automatic Fire-Alarm System. F. W. Cole, assignor to Gamewell Fire Alarm Telegraph Co. Describes the code-signaling system of the above.

1,058,726 and 1,058,727. Watchman's Signal System. F. W. Cole, assignor to Gamewell Fire Alarm Telegraph Co. The system includes an auxiliary automatic code signal to show which box has been pulled, similar to the fire-alarm system of the two preceding patents.

1,058,728. Electric Signal-Transmitting Apparatus. F. W. Cole, assignor to Gamewell Fire Alarm Telegraph Co. Describes details by which the transmitter sends a definite code signal.

1,058,730. Reversible Brush-Holder for Use with Dynamos. J. L. Creveling, New York, N. Y., assignor to Safety Car Heating & Lighting Co. The brushes are held and reversed by electromagnetic means.

1,058,731. Electric Regulation. J. L. Creveling, assignor to Safety Car Heating & Lighting Co. Electromagnetic means for varying the pressure on a resistance pile in the lamp circuit of an axle train-lighting outfit.

1,058,761. Trolley-Finder. A. Klein and J. Poss, Chicago, Ill. Has a guide arm on each side of the trolley wheel.

1,058,778. Storage Battery. W. Morrison, Des Moines, Ia. A binder for the lead peroxide plate consists of titanium oxide.

1,058,779. Separator for Storage-Battery Plates. W. Morrison. Wood separators are heated in a bath of paraffin till the volatile wood ingredients are driven off; the paraffin is then dissolved out.

1,058,816. Station-Indicator. H. S. Votaw, Laurier, Wash., and H. G. Coulson, Portland, Ind. Controlled by an electric circuit.

1,058,825. Electric Heating Pad, Blanket, Robe and the Like. F. R. Whittlesey, Oakland, Cal. Describes the method of covering and sewing in the resistance wire.

1,058,832. System of Electrical Distribution. J. L. Woodbridge, Philadelphia, Pa. Provides motor and solenoid control for compressible resistances in the field circuit of a storage-battery booster.

1,058,851. Self-Adjusting Outlet Box. O. F. Dubruiel, Duluth, Minn. The box and its disk cover are separately supported.

1,058,860. Warp Stop-Motion for Looms. G. Hames, Chelsea, Mass. Warp fault energizes an electromagnet that actuates the belt shifter.

1,058,872. Signaling System. O. T. Lademan, Milwaukee, Wis. Includes electromagnetic step-by-step selective mechanism.

1,058,885. Magnetic Tachometer. F. Meyer, assignor to Akt. Ges. Mix & Genest Telephon & Telegraphenwerke, Berlin, Germany. A number of horseshoe magnets are mounted about and parallel to the driving shaft so as to actuate the indicating disk through eddy currents.

1,058,899. Motor Vehicle. H. Pieper, Liege, Belgium. Provides electrical control for the engine speed.

1,058,902. Playing Apparatus for Musical instruments. W. C. Reed, assignor to Telelectric Co., Pittsfield, Mass. Each key is played through an electromagnet whose current is controlled as to duration and strength by the perforated music sheet.

1,058,903. Telephone-Exchange System. J. N. Reynolds, assignor to Western Electric Co. Relates to a selector switch for an automatic system.

1,058,916. Battery Installation. L. Y. Spear and G. E. Edgar, assignors to Electric Boat Co., New York, N. Y. The cells are inclosed in a double-walled ventilated tank.

1,058,986. Apparatus for Controlling Electric-Light Systems. A. W. Knutson, Galesburg, Ill., assignor of one-fourth each to F. M. Connolly and G. Sanderson. An electromagnetically actuated commutator for alternately short-circuiting part of a series circuit.

1,058,991. Process for the Production of Malleable Iron Direct from Ore. A. R. Lindblad, Ludvika, Sweden. At the bottom of a blast furnace is an electric melting furnace.

1,059,002. Rectifier. C. C. Ruprecht, Cleveland, O. An electrolytic rectifier with a rod electrode surrounded by a cylindrical electrode and means for disposing of the gas liberated.

1,059,003. Method of and Apparatus for Rectifying Electric Currents. C. C. Ruprecht. A development of the foregoing in which escape of gas is restricted so as to create a pressure on the electrolyte.

1,059,004. Electric Measuring Instrument. M. C. Rypinski, assignor to Westinghouse Electric & Manufacturing Co. A combination electric vehicle instrument with three-point switch for showing either the voltage of the battery or the current charged or discharged.

1,059,007. Electrical Burglar-Alarm. B. F. Sharp, Ambler, Pa. Controlled from several points, two of which open the circuit and two close it through electromagnets.

1,059,008. Driving Connection for Electric Locomotives. N. W. Storer, assignor to Westinghouse Electric & Manufacturing Co. The motor is connected to the drive wheels through gears, clutches and quills.

1,059,011. Trolley. E. Swinarski, Buffalo, N. Y., assignor of two-fifths to W. Tulimowski. Has retaining arms on each side of the trolley wheel.

1,059,013. Regulated-Contact Push-Button. B. Urquhart, Plainfield, N. J. Includes two pistons with a spring for each and an air space between, the button forming part of the primary piston.

1,059,014. Ozonizer. C. F. Wallace, New Brighton, N. Y. Includes two concentric glass tubes with electrodes and a cooling chamber.

1,059,028. Electric Switch. F. H. Cadogan, Utica, N. Y. A clock-operated sign flasher.

1,059,048. Frame of Dynamo-Electric Machines. F. C. Hall, assignor to Westinghouse Electric & Manufacturing Co. Relates to means for bolting

the two parts of a multipolar field frame.

1,059,056. Electric Switch. L. F. Lindstrom, Bridgeport, Conn. Specially constructed chain-guide and binding-post for a pull socket.

1,059,071. Electric Washing-Machine. R. D. Robinson, New York, N. Y. In the cylindrical tub are electrodes whose polarity can be reversed by a double-throw switch.

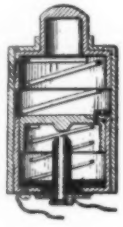
1,059,073. Antiseptic Telephone-Mouthpiece. I. S. Rosenblatt, assignor to Perpetual Germ Proof Telephone Mouthpiece Co., San Francisco, Cal. An annular block of disinfectant material surrounds the inner end of the mouthpiece.

1,059,076. Electric Plant. O. Schaller, Steglitz, near Berlin, Germany. An axle-driven car-lighting system.

1,059,086. Igniting Device for Gas-Stoves. B. D. Stevenson, Harvard, Ill. Dry cells and an induction coil are mounted in a box.

1,059,090. Electric Massage-Roll. D. Tibbals, assignor to Thobal Electric Co., St. Louis, Mo. Mounted in a metallic casing in the form of a handle is a dry cell with induction coil, whose secondary is connected to the casing and to the roll at end of the handle.

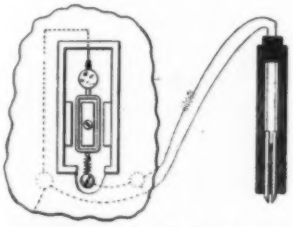
1,059,095. High-Voltage-Measuring Instrument. J. B. Whitehead, Baltimore, Md. A rod of diameter corresponding to a definite critical surface intensity is mounted axially in a cylinder to which is attached an electroscope responsive to ionization set up by corona.



1,059,013.—Push-Button.

1,059,096. System of Charging Secondary Batteries. J. A. Wotton, assignor to Electric Products Co., Cleveland, O. Provides a mercury-arc charging rectifier and means for cutting off the charge.

1,059,099. Device for Indicating Moisture in Grain, Etc. A. Zeleny, Minneapolis, Minn. A battery is connected to a hand piece with separated electrodes and to a galvanometer whose deflection is an indicator of the moisture.



1,059,099.—Electric Moisture-Indicator.

1,059,102. Railway-Car Truck. W. H. Armstrong, Los Angeles, Cal. Each wheel has a short ball-bearing axle driven through gearing by a separate motor.

1,059,110. Automatic Advertising Apparatus. H. O. Brion, Gates, N. Y. A band is alternately wound and unwound on two spools driven by a motor through automatically shifted clutches.

1,059,120. Spark Coil. W. H. Cotton, assignor of 51% to W. Lytton, Chicago, Ill. The coil is imbedded half way into each of two magnet blocks.

1,059,131. Trolley Switch. L. E. Elwell, Los Angeles, Cal. The main wire runs through continuously.

1,059,134. Commutator Motor. C. W. Fornander, Wilkinsburg, Pa. Has a laminated brush, the thickness of whose leaves is less than the width of the commutator bars.

1,059,185. Electrically Operated Annunciator. T. A. McCanna and A. Greene, Freeport, Pa. Associated with the pointer of a gas meter is a relay and remote electrical indicator.

1,059,217. Lamp Bracket. K. Rudy, New York, N. Y. An adjustable swiveled arm holds an adjustably pivoted tube containing the lamp-circuit wires.

1,059,233. Electrodeposition and Refining of Zinc. U. C. Tainton, Manchester, and J. N. Pring, Sandbach, England. The electrolyte contains 10 to 30% of sulphuric acid and a small amount of gum tragacanth; a heavy current is used.

1,059,236. Moving-Picture Screen. P. E. Thomason, Charlotte, N. C. A remote-controlled electric motor drives an endless display belt.

1,059,253. Electrified Wire-Mesh Screen. G. R. Wimbish, Hayden, Ariz. Alternate horizontal wires are connected to opposite sides of an electric circuit, the vertical wires being insulated.

1,059,255. System for Charging Secondary Batteries. J. A. Wotton, assignor to Electric Products Co. A modification of No. 1,059,096, the battery voltage controlling a circuit-breaker to cut off charge.

1,059,273. Electric Indicator. F. J. Burns and W. L. Andre, Spokane, Wash. Electromagnets shift a street-indicating curtain in a trolley car.

1,059,277. Integrating and Recording Apparatus for Meters. F. N. Connet, assignor to Builders Iron Foundry, Providence, R. I. The recording mechanism of a pitot-type flow meter is electrically actuated.

1,059,278. Photographic Flash-Lighting. H. E. Coston, London, Eng. Has electric ignition.

1,059,304. Mercury-Dropper. E. C. Ketchum, Boston, Mass. A motor-driven feed intermittently forces a little sodium amalgam on the commutator adjacent the brush.

1,059,314. Bathing Apparatus. A. J. Petter, Los Angeles, Cal. Electric lamps and reflectors are mounted in the cover of the cabinet to treat the patient with light.

1,059,322. Electrolytic Apparatus for the Preparation of Paper-Pulp. F. F. Strong, St. Petersburg, Fla. A number of porous jars containing parallel-connected electrodes are arranged so the pulp is forced through them in series, electrolyte surrounding the jars.

1,059,326. Protected Terminal-Clamping Device. A. H. Ackermann, assignor to United States Light & Heating Co., New York, N. Y. Interfitting storage-battery terminals are connected by a brass stud and nuts protected by lead caps.

1,059,328. Electrical Indicating or Recording Apparatus. W. H. Bristol, assignor to Bristol Co., Waterbury, Conn. A recording voltmeter with a stationary and an adjoining movable coil, the latter connected to the recording arm.

Patents That Have Expired.

Following is a list of electrical patents (issued by the United States Patent Office) that expired April 21, 1913.

558,480. Apparatus for Electrically Working and Welding Copper. G. D. Burton, Boston, Mass.

558,491. Electric Street-Car Motor. S. Harris, Cleveland, O.

558,506. Printing Telegraph. B. F. Merritt, Newark, N. J.

558,507. Automatic Governing Device for Motors. B. F. Merritt.

558,509. Wire-Clamp for Telegraph or Similar Wires. G. Middleton, Kirkwood, N. J.

558,517. Regulator for Electric Motors. O. H. Pieper, Rochester, N. Y.

558,518. Handle for Circuit-Breakers. W. B. Potter, Schenectady, N. Y.

558,539. Core for Electromagnets. A. G. Waterhourse, Hartford, Conn.

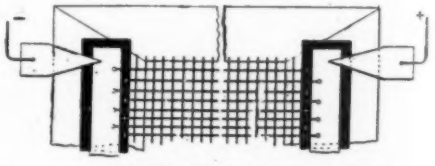
558,555. Electric Guest-Call. S. K. Gimbel, Vincennes, Ind.

558,559. Electric Rheostat or Heater. H. W. Leonard, East Orange, N. J.

558,564. Electric Alarm System. C. A. Rolfe, Chicago, Ill.

558,565 and 558,566. Railway Signal. W. G. Roome, Jersey City, N. J.

558,584. Telephone. S. D. Field, Stockbridge, Mass.



1,059,253.—Electrified Fly Screen.

558,585. Electric Metering System. J. W. Gibboney, Lynn, Mass.

558,602. Electric Signal for Railway Trains. E. J. Devine, Schreiber, Canada.

558,609. Drop-Light Electrolier. G. Peeples, Philadelphia, Pa.

558,617. Telegraph Key. W. E. Simons, Dublin, Canada.

558,634. Electric Glow Lamp. E. A. Colby, Newark, N. J.

558,650. Means for Controlling Electric Currents. P. Kennedy, Brooklyn, N. Y.

558,686. Telephone Trunk Circuit. W. H. Hennessey, Chicago, Ill.

558,687. Apparatus for Operating Electric Switches. D. Hinchliffe and A. D. Edes, Plymouth, Mass.

558,692. Method of Manufacturing Electrodes for Secondary Batteries. I. Kitsee, Philadelphia, Pa.

558,714. Electric Heating. C. S. Bradley, Avon, N. Y.

558,727. Electric Stand Lamp. R. Graves, Irvington, N. Y.

558,749. Electrically Controlled Gas Engine or Motor. G. L. Thomas, Montclair, N. J.

558,750. Multiple-Contact Switch. E. H. Wright, Chicago, Ill.

558,869. Trolley for Electric-Railway Cars. H. P. Wellman, Ashland, Ky.

558,870. Electric-Railway Car. H. P. Wellman.

558,904. Electrolier. A. Heck, Philadelphia, Pa.